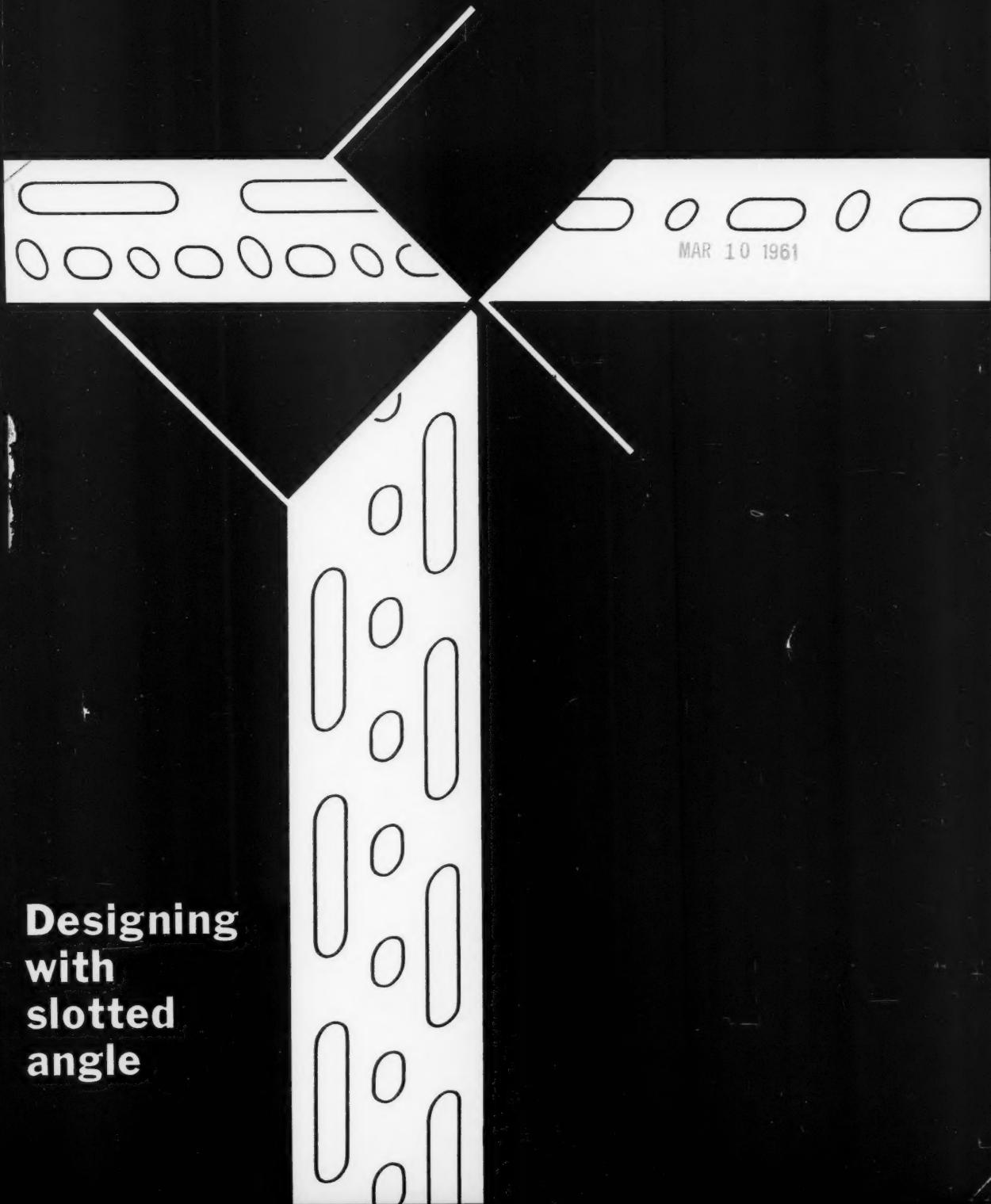


Design Engineering

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MARCH 1961



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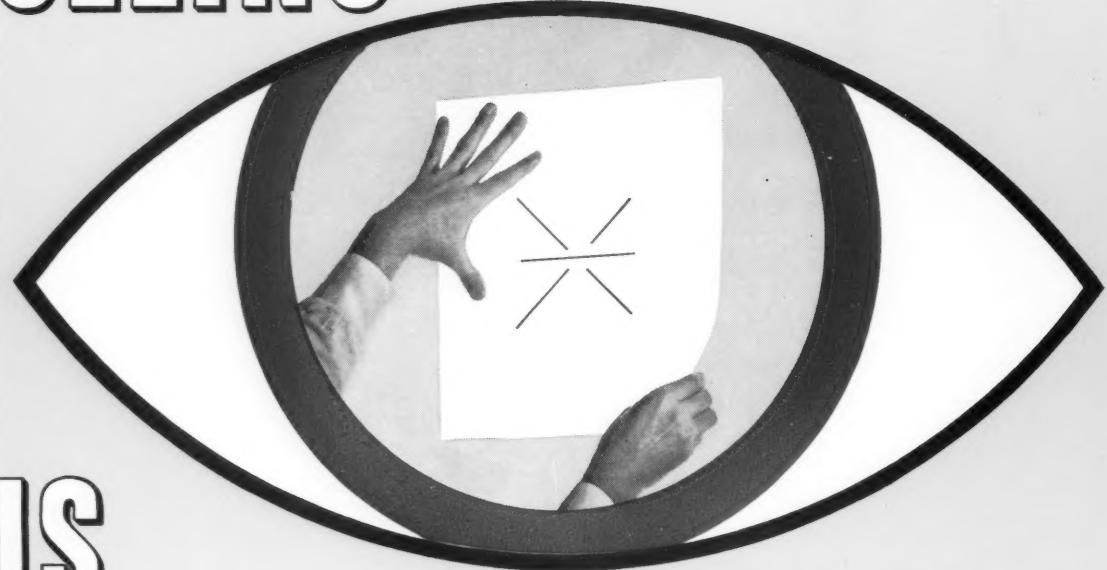
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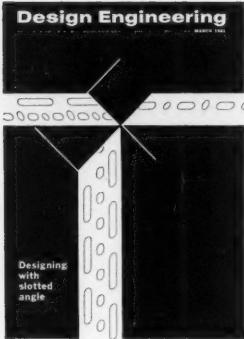
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As an engineer we've been using slotted angle for some years for all kinds of jobs—but this is the first time we've managed to have it on the cover of DE. Frank Davies, our art director, salutes this versatile material.

41 Designing for chemical welding H. J. Jankowski
Part two of this series. The main topic this month is the design of joints. Part one appeared in January.

44 Pressure reducing bearing design
How a Canadian company developed a bushing to give economical long-distance pumping of 35% slurry.

48 The trend is to modules Stanley R. Shefler
Because architects are universally making use of modular design, the engineer and industrial designer must do likewise.

52 Slotted angle — versatile design material C. S. Morgan
In hundreds of industries throughout the world slotted angle finds application after application. Here's tips for using.

55 Fluid Power Society forms in Canada
Here's how Toronto greeted the first meeting of this new technical organization. Montreal will be next to organize.

56 Free engineering costs you money W. H. Irwin
The president of one company warns against the false economy of soliciting so-called 'free engineering'.

58 Bell laboratories develops miniature transformers
The race for miniaturization leads to more and more research on vital parts for defense production.

60 Should engineers be more active in public life?
Everyone agrees they should—but not everyone agrees on how it should be done. Read what eight had to say in reply to our question.

62 High cost of short runs cut by numerical control
Cutting the tooling costs on short runs plagues Canadian industry. Here's how one company solved the problem.

64 A rush design job for TCA's big jets
Canadian industry came through when airline was faced with emergency need for inter-com equipment for service crews.

Departments

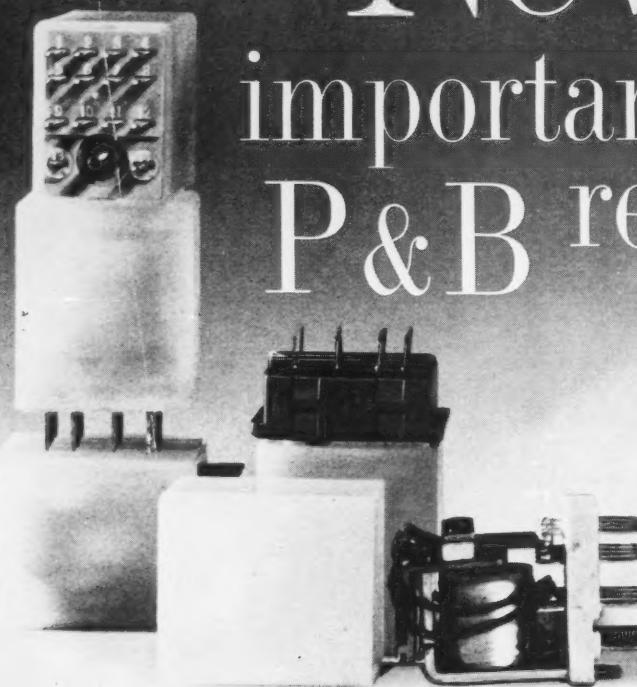
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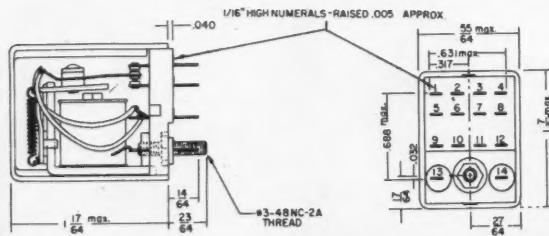
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Letters to the Editor

Patent attorney discusses a Canadian invention

Dear Sir,

In your January issue there was a letter from A. L. Perrin of Agincourt, Ont., regarding a rotating piston engine he invented during the war. He wonders why he has never seen models of his motor as sketched and why his motor shouldn't work if the Wenkel motor does.

The action of Mr. Perrin's motor as sketched reminds me of a modified kind of "reciprocating geneva" motion. It is new to me and appears most ingenious. However, I am wondering if Mr. Perrin ever caused a search to be made or if the National Inventor Council of Washington, to whom he wrote, cited and printed publication of the idea with sufficient particulars for him to obtain a copy.

Many rotary motors

I do know that rotary motors are the subject of very many patents, some dating well back into the 19th Century. By rotary motor I mean a combination of rotor within an enclosing stator. I have seen many, but probably only a few of the total. This is hardly surprising. U. S. patents are now just under the 3,000,000 mark. It is said more than half relate directly or indirectly to the automotive industry.

Is it public property?

If the Wenkel engine is similar in principle to the one sketched in your January issue, then the first applicant for patent upon it will get the patent in most countries in which application is made. This is regardless of Mr. Perrin being able to prove he invented it years earlier. Of course if it was caused to be published in print before the applicant filed, then it is public property.

The patent goes to the first applicant in nearly all countries except Canada and the U. S. which both have a "first inventor" instead of a "first applicant" patent system. But in point of practical fact, even in these countries an earlier inventor who sleeps on his common law rights usually has little chance in a Patent Office conflict with the first applicant.

This subject is of course a big and complex one. I am therefore merely generalizing briefly, particularly since your correspondent has provided scant

information. I hope however these few lines may be of interest—perhaps even of some help.

Cecil C. Kent
Patent Attorney

(*Mr. Kent is a regular contributor on patents to the business press.—Editor.*)

Inventor's reply reveals his dilemma

Dear Sir,

The pump principle shown had no correlation with the Wenkel engine. The only common points were the basic desires to get rid of alternating motion and simplify the construction of internal combustion engines.

I sent you the original letter describing the pump merely because I wanted to satisfy my curiosity regarding the statement of the National Inventor Council of the U. S. Department of Commerce. The council had written saying:

"The material has received the careful consideration of the technical staff. The examination indicates that the essentials were known to, and appreciated by, appropriate military personnel some time prior to your presentation. Many similar constructions are known and some are now in use."

The council made no reference to specific patents.

A year later I wrote to the same office pointing out that I knew of no similar design. The reply was that the council had been set up to study ideas beneficial to the national defense and not to be involved in patent litigations.

The council was the only body I knew of which would give free examination and advice, but after its second reply I dropped the matter. I have no intention of reopening it. At the present cost, patenting is a ruinous and hopeless task.

It has been my experience, in another matter relating to a more down-to-earth project, that it is impossible in Canada to have an idea even examined by the National Research Council until it has been patented.

(continued on page 70)

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A

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than the
other?



B

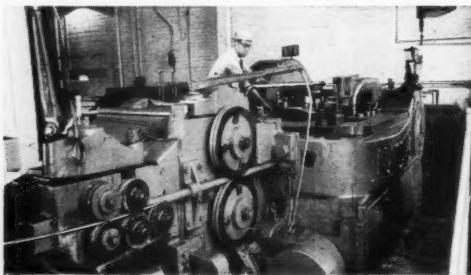
Illustrations are 1 1/3 times actual size

...and will last longer!

These "look-alikes" serve the same purpose, as components of a consumer appliance, but cost and service records quickly separate them.

Part A is Cold Headed (with secondary operations) by Stelco. It costs approximately 40% less than B, the machined part it replaced and, because it is stronger and more durable, will function longer.

Cold Heading economizes by eliminating material scrap and speeding production runs. The process also increases tensile strength and adds toughness to the material, giving greater durability to the finished part. Flattening, bending, punching, drilling, threading and other operations can be added to widen the design range.



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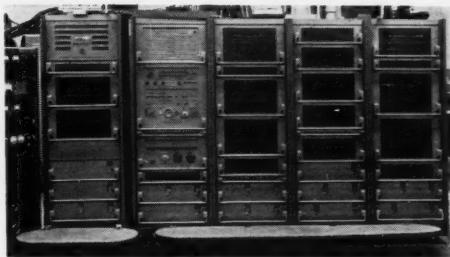
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Computer designs a computer: next step, automatic wiring

For the first time a computer has been built from information supplied by a computer. The new computer is being used in the target area of the Atlantic missile range as part of the U. S. Army's anti-missile defense system. The entire logic network, consisting of 47 sub-assemblies, was built from wiring diagrams, assembly information and parts lists produced by a specially programmed, general-purpose digital computer. Bell Telephone Laboratories engineers report that the system requires less than 25 minutes per sub-assembly to produce manufacturing information which would have consumed four man-weeks of manual effort with conventional drafting methods.

In addition, manufacturing information can be converted into a control program for an automatic wiring machine, which would do the assembly work. Initial experiments on this aspect of the program are now under way, and results indicate that automatic wiring of the mechanically designed computer is feasible.



Some of the racks of equipment that make up the computer designed by a computer.

Soviets sign agreement for technical translations

Improved communication between Russian and American scientists will flow from an agreement signed recently between the official Soviet book agency and a New York publishing firm. Under the agreement Russian technical and scientific books, including those reporting conference proceedings, will be made available in the English-speaking world within six months of publication in the USSR. Where necessary the English translation will appear simultaneously.

The first instance of such simultaneous publication occurred with the appearance of *The Structure of Glass* both in Leningrad and New York. The book is reviewed in Designers' Bookshelf in this issue.

The New York firm, Consultants Bureau, says the agreement is an indication that the Soviet book agency, Mezhdunarodnaya Kniga, expects a prolonged period of free trade with the U. S. The contract is for six years with automatic renewal provisions at two-year intervals. Every book chosen for translation will have the recommendation of both Russian and American scientists as being an outstanding contribution to the existing literature on the subject.

Shock-wave tests in glass tube point to better propulsion system

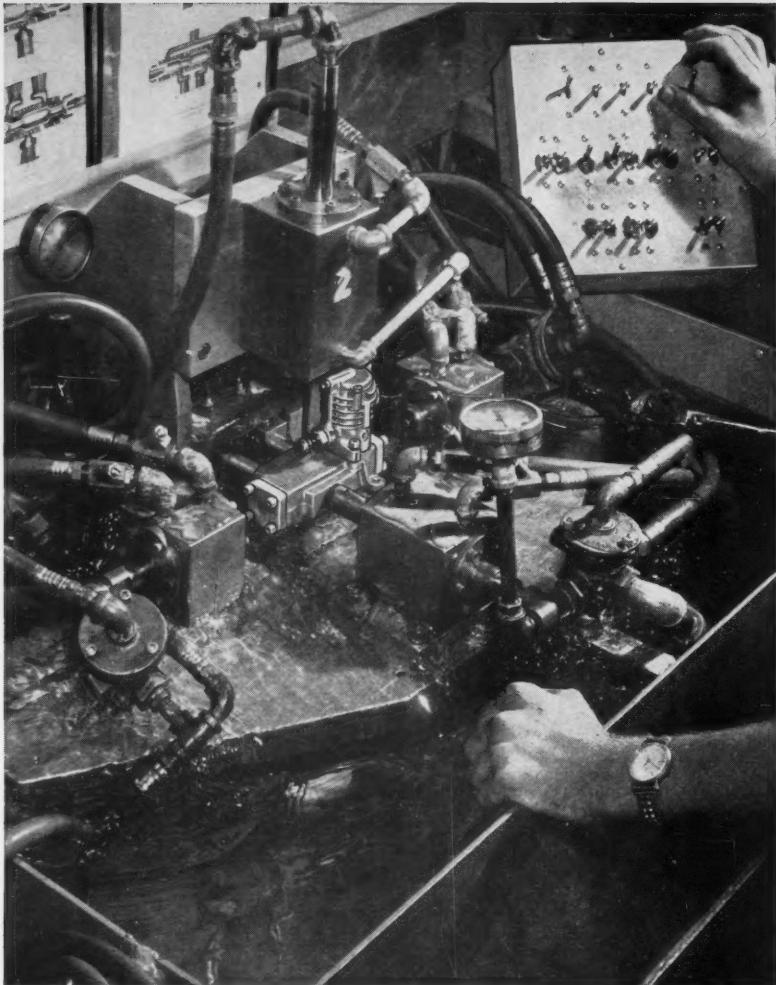
Two shock waves traveling 80 times the speed of sound have been made to collide head-on in a hydromagnetic tube made of glass. The experiment was part of a study of high-temperature gases made by scientists at the Boeing Airplane Co., who explain that the studies could have important results in the development of effective ion and plasma-propulsion systems. The shock tube is expected to be useful in measuring temperatures of gases up to several million degrees; it will also be used in the study of microwave emission and energy loss through radiation.

The shock waves are driven through the 12-ft.-long glass piping by a surge of electrical power equal to the output of four Grand Coulee dams. The naked eye catches only a brief glimpse, but the collision has been recorded on film. The shocks create a gas temperature within the tube of about one million degrees, though the shocks last only a few microseconds. The shock waves initially race at 300 times the speed of sound, but after traveling about 60 inches toward the centre of the tube they "slow down" to about 80 times faster than sound, which is still 25 times the speed of a rifle bullet.



Section of the glass piping in which shock waves were driven.

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How to get a name for your new product

The first organization in the industrial design-marketing field devoted exclusively to corporate and brand name selection has been formed in New York under the title Names Inc. It was created to help companies which are becoming concerned over the scarcity of names available for new products. Names Inc. is a subsidiary of Lippincourt & Margolies Inc., the Park Avenue industrial designers. Its services will include the collecting, screening and evaluation of names for products; the development of criteria against which these names can be evaluated; and the provision of legal activity required in obtaining and clearing names.

Walter P. Margulies, president of L & M, says poor name selection has been a significant factor in the high rate of new product failures.

Here's a new ideas source for product engineers

Business firms are turning to the campus for ideas to combat recession problems. The Director of Engineering Institutes at the University of Wisconsin says many companies are finding it profitable for their personnel to participate in educational seminars: They find them a source of new ideas and techniques. He has announced a schedule of meetings covering programs from noise control to nomography at U. of W. in the next few months.

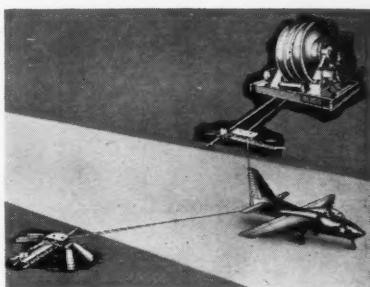
If you're near Madison, Wis., on May 9 you might want to take in the seminar on product development. Otherwise perhaps your own university might be arranging a similar program.

Emergency barrier stops 210 mph jet in 1,000 ft.

This jet age increases the danger of planes over-running the runway. When this happens, whether because of mechanical failure, icy conditions or other causes, the problem is to stop the plane externally, yet without imposing stresses so severe that the craft or its passengers are affected. A U. S. company has come up with an arresting unit which will safely stop within 1,000 feet any current jet fighter travelling at 210 mph, and the U. S. Air Force has ordered 110 such barriers at a cost of five million dollars.

Basically the arresting unit consists of a braking engine installed underground alongside the runway, with two reels containing strong, light nylon tapes drawn out over pulleys at each end of the runway. When a pilot finds that he cannot stop his plane in time, either in landing or during an aborted takeoff, he drops a specially installed hook. This catches the engagement cable. As the tape plays out, the aircraft is brought to a halt by a braking force automatically applied to stop the rotation of the tape wheels. The braking engine, a compact unit about 5 ft in diameter, is capable of absorbing over 33,000 hp within the required safety distance.

A major advantage of the new arrestor is that it remains at the ready indefinitely and can be reset in less than three minutes. It will replace and augment other barrier systems now in use by the Air Force. According to the manufacturers, it can be adapted to handle heavy jet liners by the use of two or more arresting engines in tandem. Major airlines have expressed interest and the Federal Aviation Agency is now conducting a study.



Engagement cable hooks on to jet fighter, brings it to a halt.

This is bad news for foot-in-door salesmen

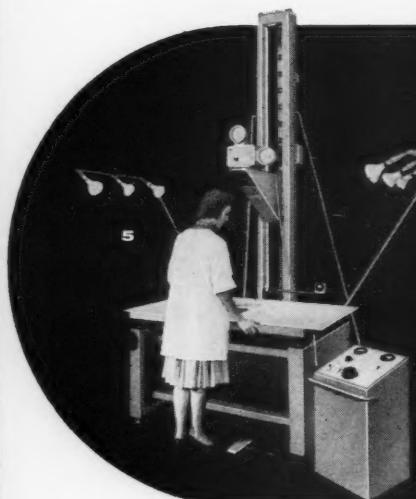
Now the housewife has the same push-button convenience as the business executive. A new housing subdivision in Toronto has a built-in intercom system linking the master unit in the kitchen to remote units in other rooms and at the front door. The housewife can check on the identity of callers just by the flick of a switch. While baby is asleep she can leave the intercom on and listen for sounds of distress. If Jack has trouble getting up she can keep prodding him while fixing breakfast; at the same time she can be filling the bedroom with radio music from the kitchen set.

Homes in this development cost between \$25,000 and \$40,000, but you can get the intercom system without laying out that much money. It's available in kit form for do-it-yourselfers at \$170.

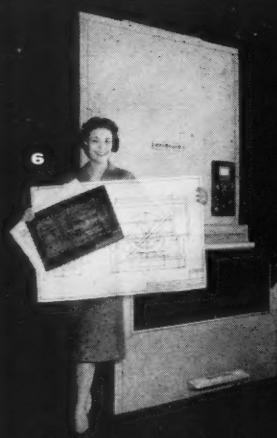
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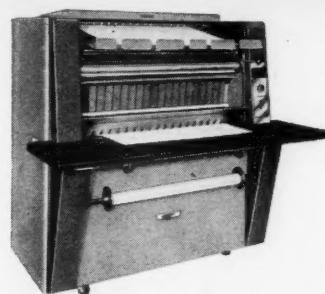
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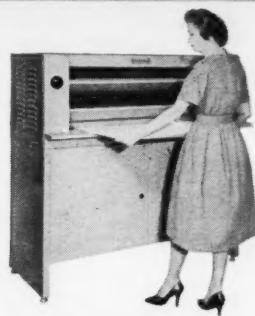
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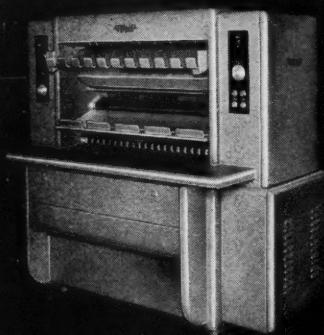
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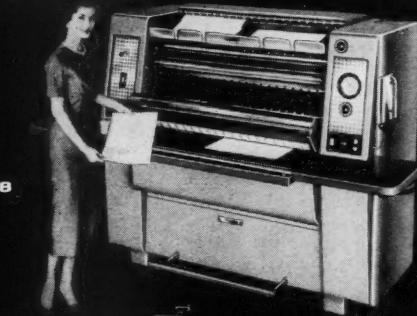
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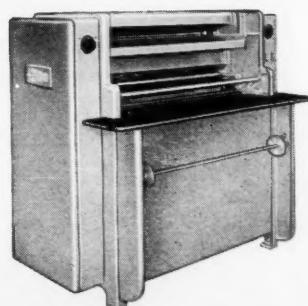


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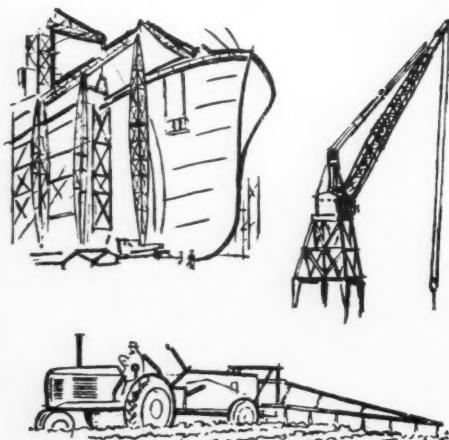
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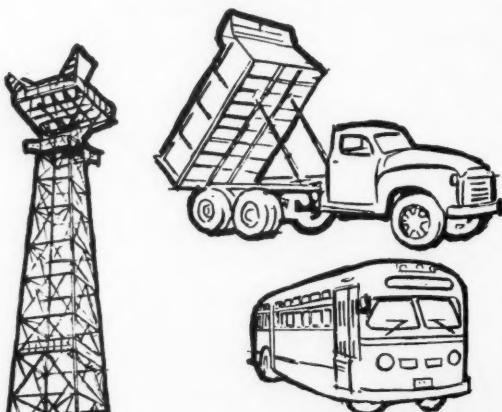
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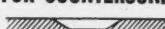
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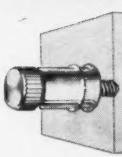
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Quick, positive locking, by fractional turn. Tight seal formed by compression of leaf spring. Alignment and stack height not critical. Approved for aircraft use. Rugged. Extra strength provided by swaged nose. Vibration resistant.

FOR COUNTERSUNK

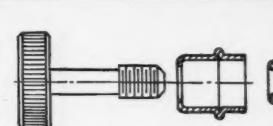
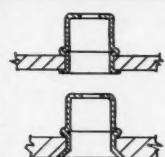


FOR OVAL HEAD



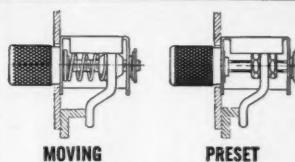
RETRACTABLE SCREW FASTENERS

Stand-off thumb screws from stock to eliminate costly, special fasteners. Installed quickly without special tools. Accommodate misalignment. Complete range of standard sizes.



ADJUSTABLE PAWL FASTENERS

Pre-assembled, quickly installed. Accommodate variations in frame thickness up to $\frac{1}{2}$ inch. One-quarter turn closes, additional turns increase grip pressure. Attractive appearance, long life. Moving or pre-set pawl. Miniature, intermediate and large sizes.

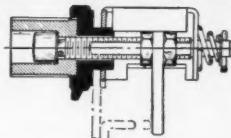


MOVING PRESET



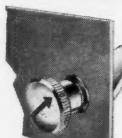
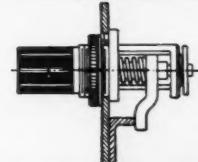
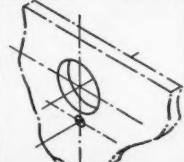
ADJUSTABLE PAWL FASTENER

Has twin-knob control. One knob controls pawl, pointer shows pawl position. Other knob controls amount of pressure to seal closure with uniform pre-set compression. Easily installed.



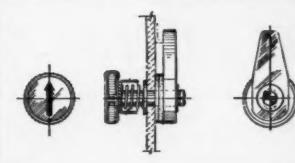
ADJUSTABLE PAWL FASTENER

Compact and rugged. Eliminates rivets or bolts to save installation time. Three types cover grip range up to $\frac{3}{4}$ ". Supplied either with integral metal and plastic knob, plastic knob or for your knob.



ARROWHEAD DOOR LATCH

Requires only one hole to install. Operates on quarter turn. Holds under spring tension. Arrow shows pawl position; no pawl stops required. Uses minimum inside space.



Free Fastener Handbook

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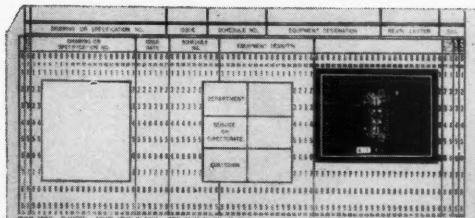
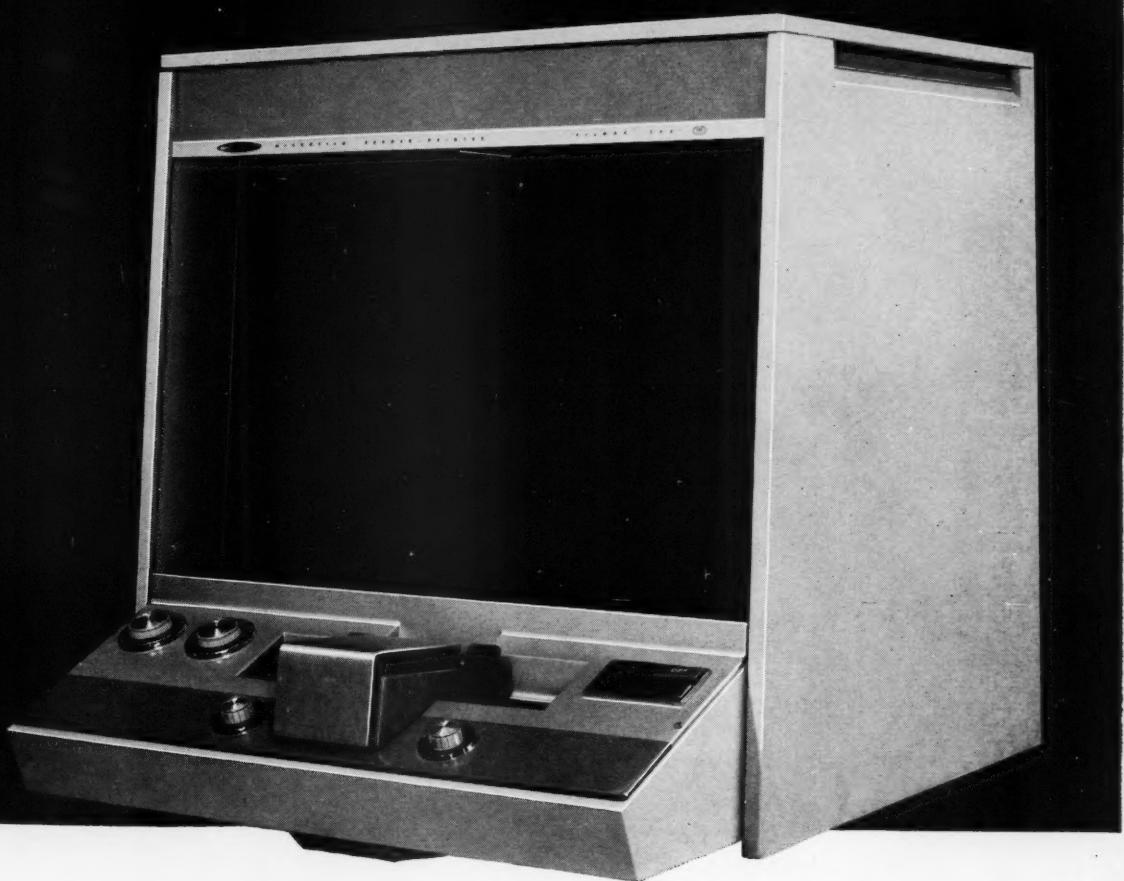
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DESIGN ENGINEERING MARCH 1961



Design Notes on Fluid Power

RELEASE NO. 7: WHAT TO LOOK FOR IN A CYLINDER

Quality in an air cylinder or a hydraulic cylinder is a function of a) design, b) materials used and c) quality control in manufacture. Almost everyone thinks he can make a good cylinder for half the price someone else is charging. Happily, most of these optimists are never called upon to prove their point.

It is a fact that many cylinder applications are very easy and gentle; there are also many that are rough and rugged. Here are some of the points that make an application a difficult one:

- High speed, above 100 feet per min.
- Rapid cycling.
- Long stroke with an unguided rod.
- Excessive side loads.
- High surge pressures.
- Excessive tension loads.
- Abrasive atmosphere.
- Corrosive atmosphere.

When you operate a cylinder faster than about 30 FPM, use a cushioned model. The cushions in a well-designed cylinder will decelerate most normal loads. If the inertial loads are great and velocities

are high, it is desirable to add external means of deceleration in the valving.

Always try to design for accurate guidance of your rod and load with a long stroke; if you cannot, this is where a poorly-designed cylinder will give itself away most quickly: look at the length of the rod bushing and piston, check the clearance between piston and bore. In extreme cases, use a longer stroke than needed, with a stop-tube to prevent over-extension. These remarks also apply if your application exerts excessive side loads on the rod. High surge pressures should be eliminated in your plumbing. Excessive tension loads on an inferior cylinder will cause the rod to pull out of the piston (personnel safety can be involved here).

Cylinder boots offer part of an answer to abrasives and corrosives. As the cylinder extends, the boot must breathe, so you must ensure that it does not breathe in the very atmosphere you are trying to keep out. If it does get in, the boot ensures that it stays in. Your fluid power supplier can suggest a more complete answer.



SHEFFER CLA clamping cylinder, 150 psi air. Available only in 1 1/8" bore from stock in 1", 2" and 3" strokes, with mounting accessories.



SHEFFER C10 heavy-duty cushioned air cylinder, 1 1/2" to 6" bore, four mounting styles. The C20 model is available where cushions are not required.



SHEFFER A super-duty air cylinder, 1 1/8" to 14" bore, eighteen mounting styles, selection of rod diameters, adjustable cushions optional.



SHEFFER CLH hydraulic clamping cylinder, 1500 psi hydraulic, 1 1/8" bore only.



SHEFFER HH hydraulic cylinder, 2000 psi heavy-duty, 3000 psi non-shock, 1 1/8" to 12" bore and larger, all mounting styles.



SHEFFER UH super-duty hydraulic cylinder, 3000 psi heavy-duty, 5000 psi non-shock, 2" to 12" bore, nine mounting styles.

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Notice to Purchasing Agents and Engineers!

Now, more than ever, it's time to cut costs!

Speed Nut Fasteners give savings of 30% to 75% or more over other methods

With competition increasing from home and abroad, it's time to re-examine your production costs. The use of Speed Nut fasteners in your assembly will greatly reduce time and material costs and affect substantial handling savings.

Prove to yourself that Speed Nuts can save you time and money by taking advantage of our FREE Fastening Analysis Service.

Here's how it works:

Our skilled engineers will take one of your finished units, carefully disassemble it, study it piece by piece and

reassemble it using Speed Nuts where applicable. Then, in a detailed report, we will provide an accurate accounting of the time and cost savings realized.

There are over 8,000 different types and sizes of Speed Nuts now in production. If, however, there is not a Speed Nut that is entirely suitable for your particular application, our creative engineers will develop one that is.

Take advantage of our free analysis service now. Learn how Speed Nuts can improve your profit picture, and make your product more competitive.

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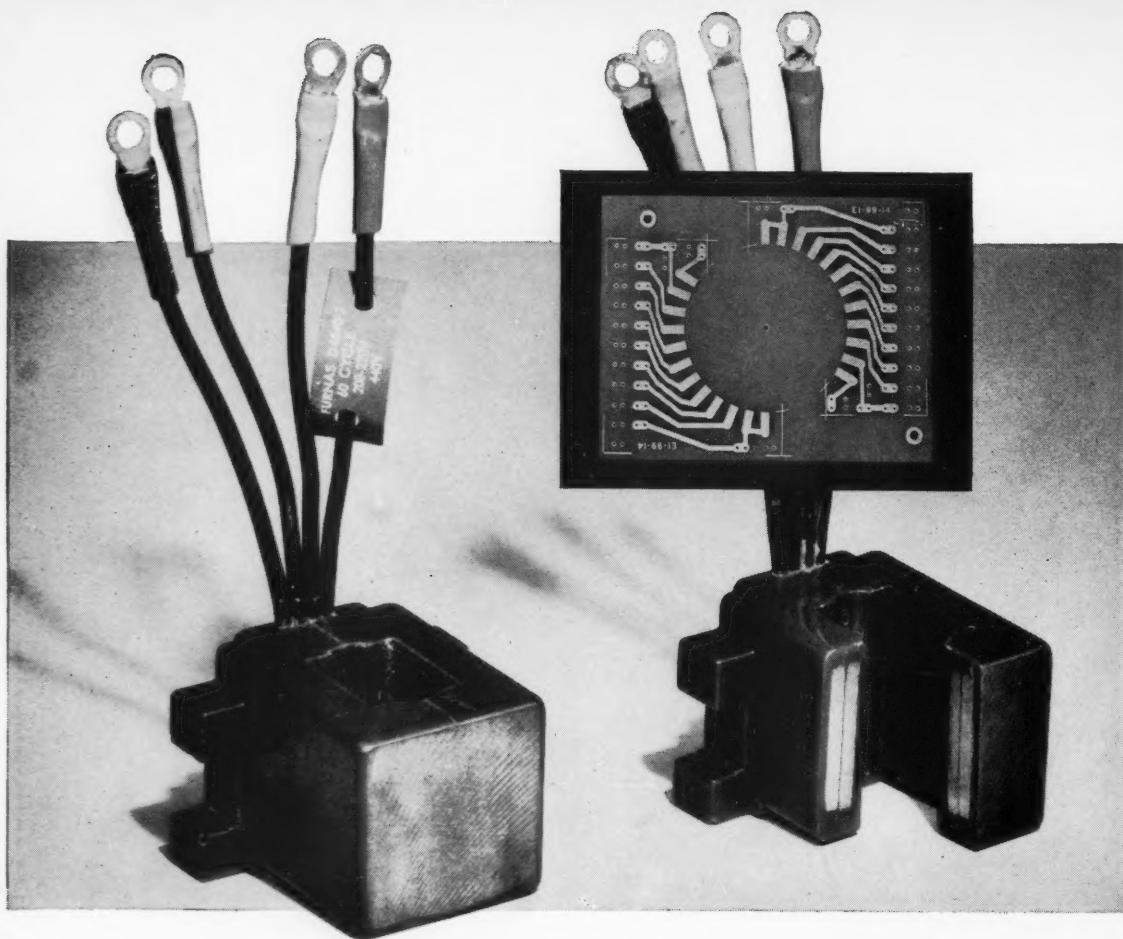
I want to know if Speed Nuts can lower my production costs, improve my profit picture. Send me complete details on your Free Fastening Analysis Service.

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When unusual conditions call for insulation that endures . . .

THERE IS NOTHING BETTER THAN EPOXIES

Circuit and equipment engineers in electrical and electronic fields are rapidly reaching the same conclusion—that no other type of insulating material now available can provide as many desirable properties as epoxy resins. Here is one high-quality dielectric material that most nearly approaches the ideal sought by designers and users alike.

BAKELITE Brand epoxies have already been proved in many applications. In laminated backings for printed circuits, they combine with glass fiber to give high physical strength along with exceptional resistance to heat, moisture, flame, and chemicals. For encapsulating, the additional advantages of high impact strength, dimensional stability, and excellent dielectric properties have solved many technical problems. Furthermore, epoxies do no shrink during cure—they protect better!

Newer developments—such as in nuclear energy and radiation, missiles and rockets, and underwater exploitation—are creating more demands for superior insulation with the unique combination

of properties afforded only by epoxies. If you are stymied by an insulating problem still on your drawing board, let Union Carbide Canada Limited help you find the appropriate solution before it becomes a production handicap. Write Union Carbide Canada Limited, Bakelite Division, 123 Eglinton Ave. East, Toronto 12, Ontario.

EPOXY RESIN INSULATION GIVES YOU SUPERIOR—

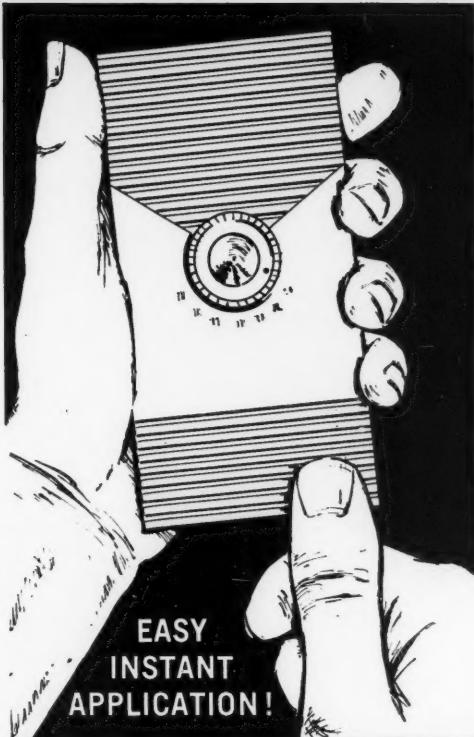
**HEAT RESISTANCE • MOISTURE RESISTANCE
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IMPACT RESISTANCE • FLAME RESISTANCE**

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26

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makes a
dramatic difference
on every product!

Choose from the largest variety of laminations, gauges and special effects in the field. Available in continuous rolls, cut-to-size sheets, die cuts or in widths as narrow as 1/4 inch.

Our design engineering department will assist you in selection and application to meet your individual needs. No cost or obligation.

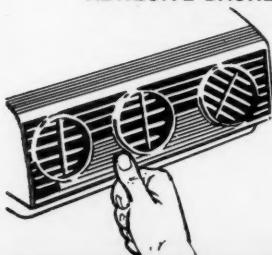
ALL FABRICATION DONE BY US EVERY STEP OF THE WAY

Every process in the fabrication of Mirro-Brite Mylar is done in our own factories...metalizing, coating, embossing, printing and lamination. This insures uniform quality control plus significant savings to you.

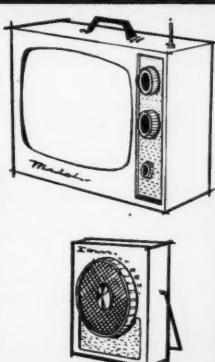
PRESSURE SENSITIVE MIRRO-BRITE
MADE WITH "MYLAR" IN ROLLS * SHEETS STRIPS DIE CUTS

*Ready Strip

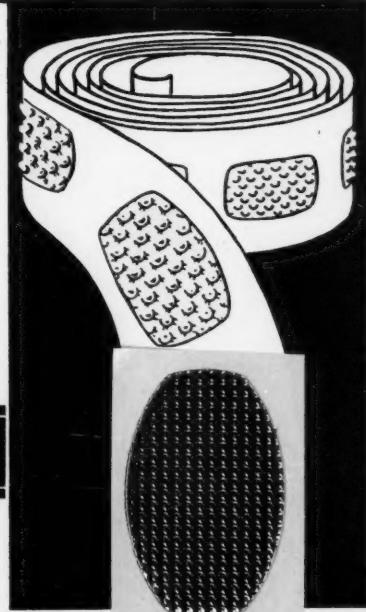
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Edwards of Canada Limited, Owen Sound, Ontario. Branches across Canada.



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6102



OIL SEALS in Design Engineering



Garlock KLOZURE* Oil Seals stop oil leakage at bearings, increase efficiency of Denison Variable-Volume Hydraulic Pumps.

Denison designs hydraulic pumps around Garlock KLOZURE Oil Seals to assure maximum sealing efficiency.

Where pressures are too high for ordinary lip seals, KLOZURE Oil Seals prevent leakage of hydraulic oil and protect vital bearings as temperatures reach 150°F, pressures rise to 35 p.s.i., and shafts whirl at 1800 r.p.m. In use for the last twelve years, the seals have given complete satisfaction on the well-known line of axial piston and vane-type pumps made by Denison Engineering Division of American Brake Shoe Company.

Wherever bearings must have the best protection, Garlock KLOZURE Oil Seals are specified. On pumps like Denison . . . in steel mills . . . on power shovels and lift trucks . . . for motors, KLOZURE Oil Seals prevent leakage of lubrication, seal out harmful foreign matter. Whatever the application, there is KLOZURE Oil Seal to do the job. They are oil and grease resistant, impervious to mild acids and alkalies, non-abrasive, and will withstand temperatures from -40°F to +250°F. For extreme conditions, Garlock furnishes sealing elements resistant to practically any fluid, and serviceable as high as +500°F.

Availability is another prime reason for selecting Garlock KLOZURE Oil Seals. Once your design is finalized, you may select the proper seal from over 1800 stock models available from 180 national bearing distributors, including one near you.

It makes good sense to design with KLOZURE Oil Seals, as Denison and hundreds of other leading companies have found. See how you can benefit—call in your local Garlock representative. You will find him at the nearest of the 26 Garlock sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-181. Garlock of Canada Ltd.

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General Offices: Toronto, Ont.
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Winnipeg, Edmonton, Vancouver
Plastics Div.: United States Gasket
Company

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

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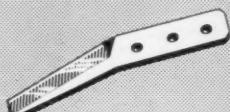
CORROSION



NOZZLES



PUG MILL PADDLES



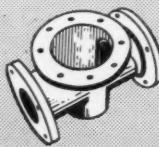
KNIVES



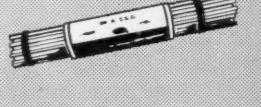
PUMP SLEEVES



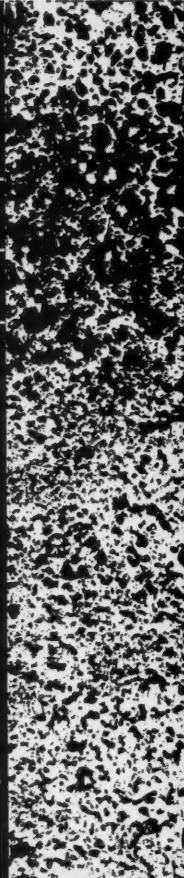
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HARDFACING RODS



There's one control for this billion dollar destructive menace . . . an ever increasing number of cobalt or nickel base alloys produced in Canada by Deloro Stellite.

For information on how Deloro Alloys meet common commercial types of corrosion, send for bulletin SP-13.

If downtime due to the lightest corrosive wear or most destructive chemical condition is interrupting your production, call on the research and experience of Deloro Stellite. They will be glad to have a technical representative discuss your problem fully with you.



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DIVISION OF DELORO SMELTING & REFINING
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DESIGN ENGINEERING MARCH 1961



- **70 DIFFERENT STANDARD MODELS**

- **SPECIALS BUILT TO ORDER**

Marsland permanent magnet loudspeakers are manufactured in round, square and elliptical shape and in sizes from 2" to 12", with all conventional Alnico 5 magnet weights in the magnetic structure.

Standard lines provide voice coil diameters of $\frac{9}{16}$ ", $\frac{3}{4}$ " and $1\frac{1}{4}$ " with impedances of 3.2 and 6 ohms. Higher impedances up to 45 ohms are available to special order.

Marsland has built millions of economical, high quality loudspeakers suited to all types of commercial applications. Stock models include: the "Imperial" line, particularly noted for faithful sound reproduction; moisture-proof models for outdoor or special inside installations; blast-proof speakers and enclosures for specialized tasks in industry and for military applications.

Detailed Information Available On Request



MARSLAND LOUDSPEAKERS

M/5

MARSLAND ENGINEERING LTD. KITCHENER, ONTARIO, CANADA

MARSLAND PRECISION EQUIPMENT LIMITED WATERLOO, ONTARIO

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Savings Pile Up With Torrington Needle Bearings

You get performance-plus at a low, low unit cost when you specify Torrington Needle Bearings. A full complement of small-diameter rollers provides a maximum number of contact lines. The result—a higher radial load capacity at a lower unit cost than any other bearing of comparable size or performance.

Precision rollers operate smoothly and efficiently, with a low coefficient of starting and running friction. Positive roller retention is insured by turned-in lips on the outer shell, permitting faster and easier installation or assembly.

Your Torrington representative is an expert on Needle Bearings. For full information on how they can bring savings and improved product design and performance call Torrington—maker of every basic type of anti-friction bearing.

TORRINGTON NEEDLE BEARINGS FEATURE:

- Full complement of retained rollers
- Unequalled radial load capacity
- Low coefficient of starting and running friction
- Low unit cost
- Long service life
- Compactness and lightweight
- Runs directly on hardened shafts
- Permits use of larger and stiffer shafts

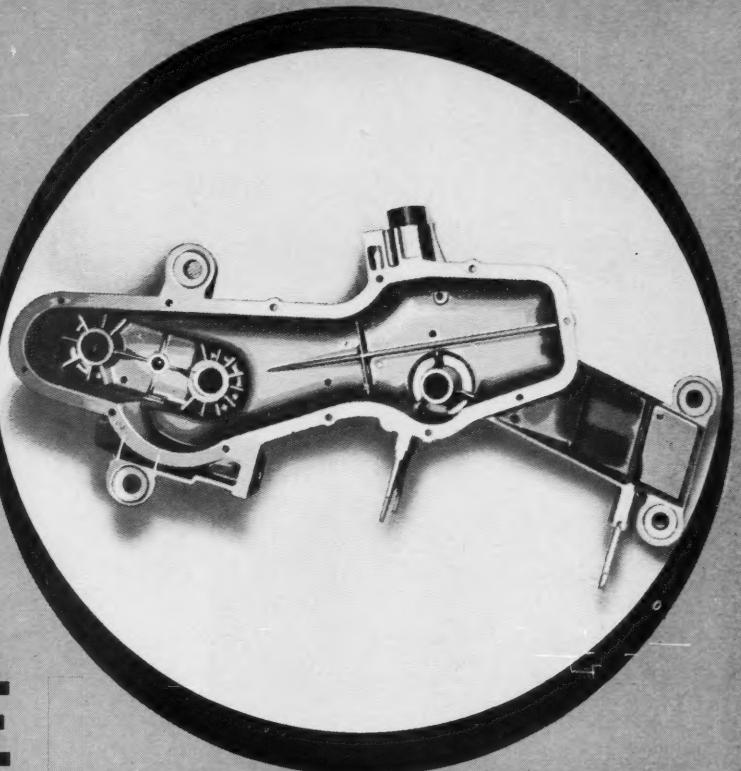
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ZINC made this **Low-Cost ANSWER POSSIBLE**



The Problem: To produce this complex washing machine part as efficiently as possible.

The Answer: Zinc die casting.

The design of this part as a zinc die casting was simplified by the versatility of the metal. Die cast design in zinc can safely include thin sections and still maintain a high strength-to-weight ratio. Section thicknesses may be varied in the same casting. Because of zinc's dimensional stability, complex shapes can be easily and consistently mated. These factors plus zinc's smooth "as cast" finish and innate, corro-

sion-resistant characteristics make parts, die cast from this metal, suitable for a very wide range of uses.

Zinc saves money in die cast production because no other metal costs as little or permits such efficient operation of equipment.

Zinc die casting is an effective answer to complex design problems.

DIE CAST WITH ZINC FOR EFFICIENCY AND ECONOMY

COMINCO

THE CONSOLIDATED MINING AND SMELTING COMPANY OF CANADA LIMITED, MONTREAL

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THESE SURFACE TRACES

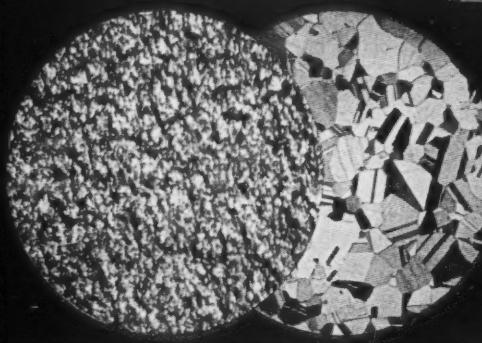
prove that you can cut polishing costs with Formbrite, Anaconda's superfine-grain drawing brass.

STANDARD DRAWING BRASS

(grain size, .045 mm) — after 40% elongation



ENLARGED SURFACE TRACE showing the roughness that causes "orange-peel" effect in the working of standard drawing brass. Smoothing such mountains down to the valleys takes considerable cutting. For small deep-drawn products, up to five polishing wheels might be needed. Polishing compound costs run high; production rates, low. Bottlenecks hamstring operations.



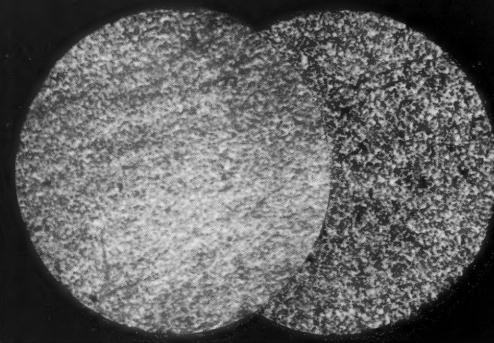
THE STRETCHED SAMPLE of standard drawing brass looks like this (left, above) when seen in oblique illumination and magnified 20x. Its microstructure is shown 75x at right. This is the kind of drawing brass that's been used for decades for stamped or drawn brass products and the micrographs show in another way why polishing costs have been high.

FORMBRITE DRAWING BRASS

(grain size, .005 mm) — after 40% elongation



ENLARGED SURFACE TRACE showing Formbrite's smoothness even after deformation; the test of polishing characteristics of a drawing brass. It is relatively easy to level these little hills on the surface of Formbrite. In many cases, users find they eliminate cutting operations altogether, need only a simple color buff. Finishing savings run up to 50%.



WHEN SEEN IN OBLIQUE ILLUMINATION and magnified 20x by the microscope, the stretched Formbrite surface looks like this (at left, above). Its microstructure is shown 75x at the right. This uniform superfine-grain structure is produced by special procedures of rolling and annealing.

FORMBRITE is springier, harder, more scratch resistant than the usual drawing brasses in the same standard tempers. Yet it retains remarkable ductility for forming and drawing — even such deep-drawn products as pen barrels. And Formbrite costs no more than ordinary drawing brass, despite its superiority. For fuller details write: Anaconda American Brass Limited, New Toronto, Toronto 14, Ontario. Sales Offices: Quebec City, Montreal, Calgary and Vancouver.

C-6110

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FORMBRITE*

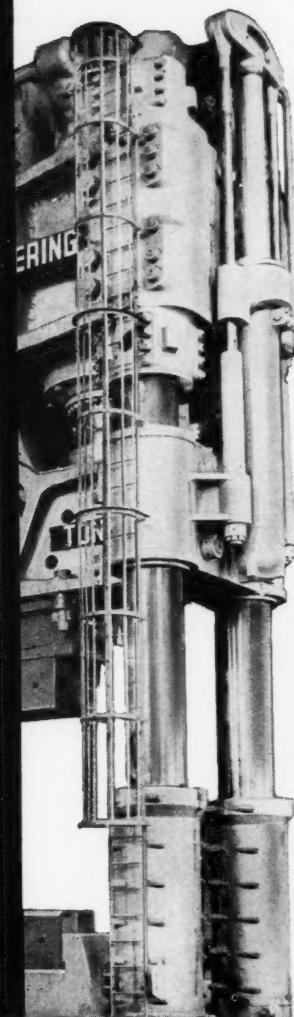
Superfine-Grain Drawing Brass
a product of

ANACONDA*

*Trademark Reg'd.

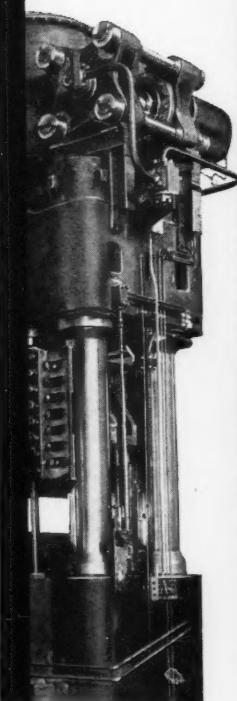
7,000 TONS

FORGING



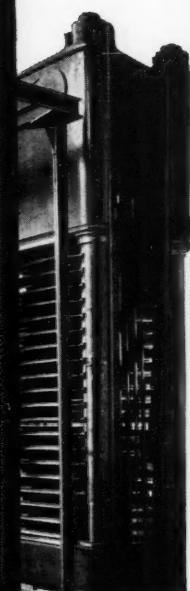
3,500 TONS

FORMING



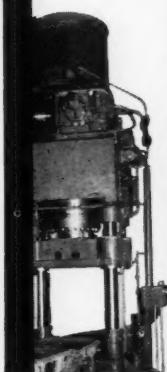
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800 TONS

BALING



**200
TONS**
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You benefit from 30 years' experience when you let Dominion design and build your hydraulic presses. Any size and capacity—any application. For full details on the widest range of Canadian-designed presses, please contact

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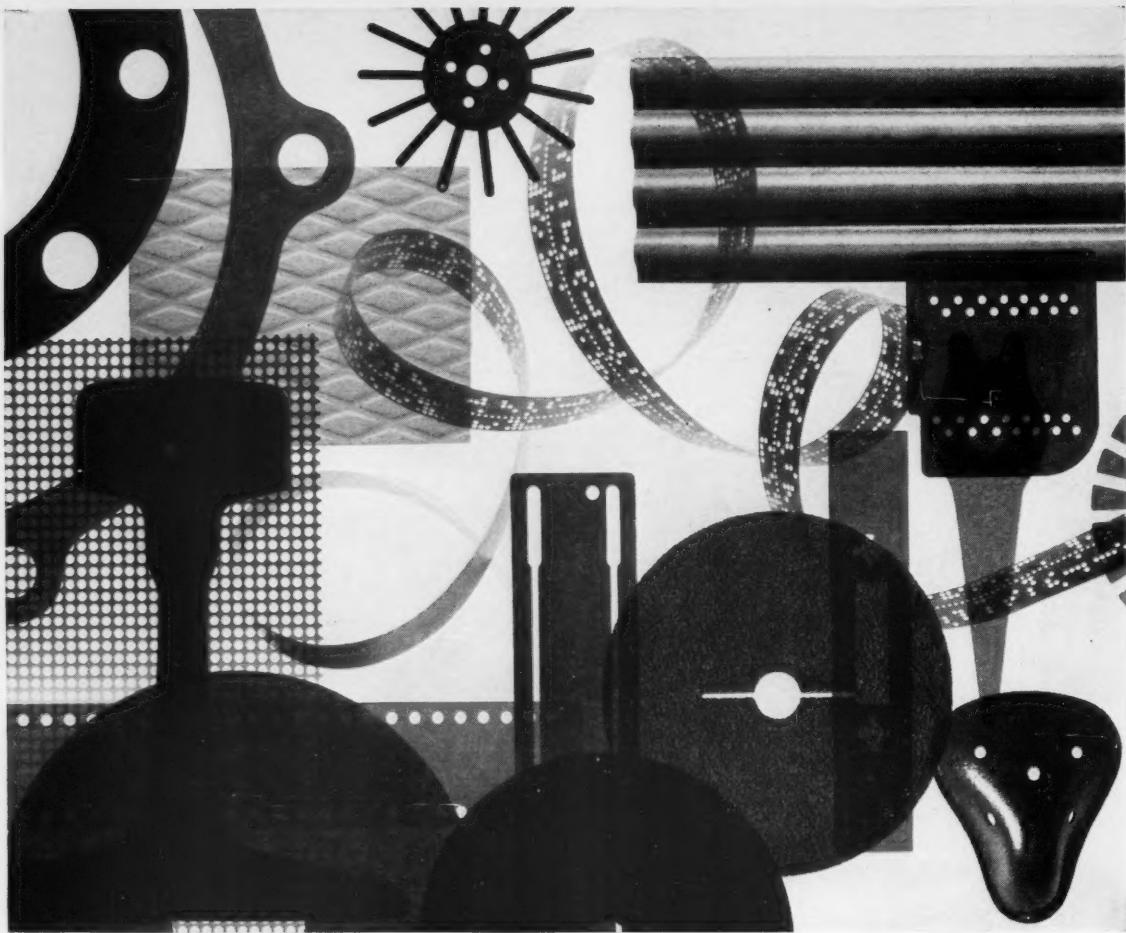


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Consider the many ways this plastic can toughen your product, lighten your problem

National Vulcanized Fibre is one of the most do-more, save-more, get-around materials ever produced. Thousands of jobs well done have established its reputation. Yet there are still other cost-cutting applications to be explored, many that no other plastic can handle.

What is Vulcanized Fibre? A tough, dense cellulosic plastic. As track insulation, thousands of tons of Vulcanized Fibre are now absorbing the steady beating of trains passing over. Has the highest arc resistance of any material known; is a class "A" electrical insulation. Low thermal conductivity, high resiliency, great shock and abrasive resistance. Shrugs off oil, gasoline, most solvents. A most un-ordinary plastic. Weighing but half as much as aluminium, Vulcanized Fibre is one of the strongest of materials for its weight.

You can machine, punch, form, deep-draw; combine with rubber, copper, laminated plastic, and other materials. Takes polish, paint, embossing. Consider design and shape . . . you'll find Vulcanized Fibre as motor slot insulation or in intricate forms such as gear assemblies.

There are 16 standard and many special grades, among them "Pyronil", which is fire-resistant. You may find precisely the properties needed to make your

product a better buy. There's a free sample kit waiting for you at the nearest National sales office. Or write directly, Dept N3, Toronto, Ontario.

116 Choices: One Source This is the latest count of the different plastics and grades National can offer in your search for the *one best material*. Add to this total *the one* special grade that can be developed from scratch to meet your particular need. This full range of materials is backed by complete engineering services . . . from application assistance up to and including the delivery of Canadian made, 100% usable, precision-fabricated parts . . . in any quantity, on time!

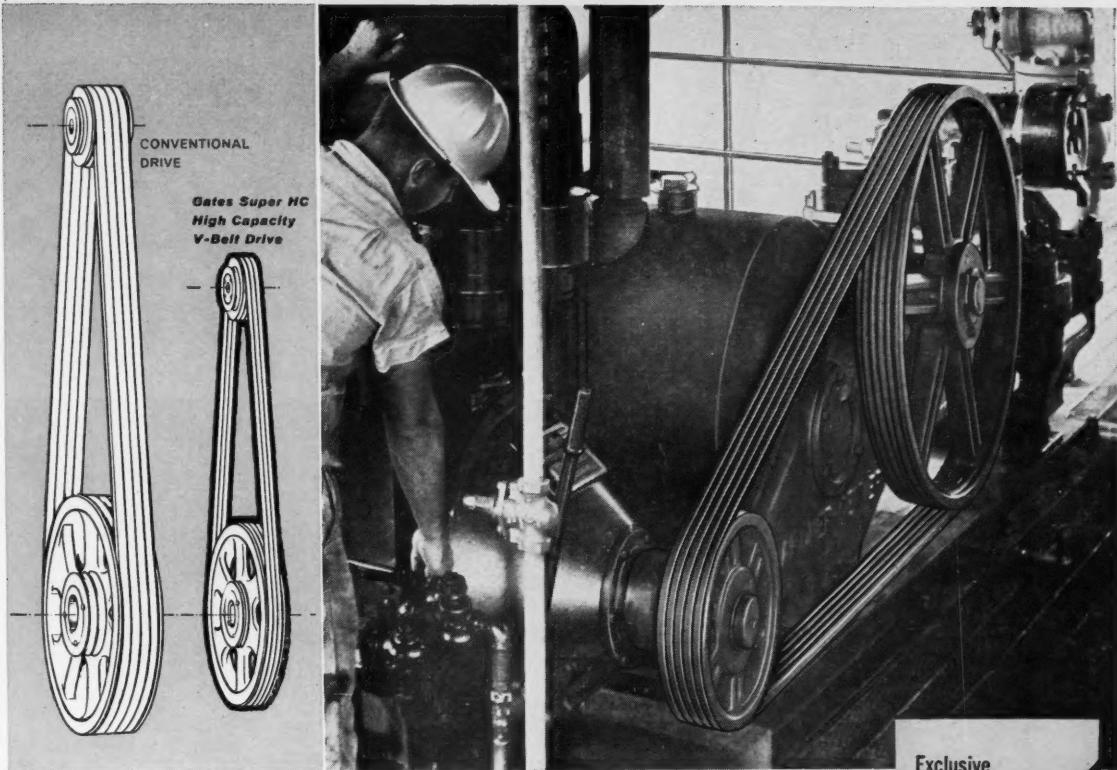
Call the National Sales Office near you. It's a direct line to single-source help on your current materials problem.



NATIONAL FIBRE CO. OF CANADA

Atlantic & Hanna Avenues, Toronto • 1405 Bishop Street, Montreal

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Gates High Capacity V-Belt Drive handles greater power in less space!

Gates Super HC V-Belt Drives, in use throughout Canada on all types of machines, are meeting the industry-wide demand for a means of transmitting greater power in less space.

Because of exclusive design features, Gates Super HC High Capacity V-Belts handle up to 3 times more horsepower than conventional V-belts in the same space. Or the same power can be handled with fewer belts and smaller sheaves, saving up to 50% in drive space and cutting drive costs as much as 20%.

Further, with smaller, lighter sheaves, bearing loads are reduced. Guards, ma-

chine housing, countershafts, etc., can be smaller. Shipping weight is less.

The drive can operate at belt speeds up to 6,000 ft/min without dynamic balancing. This permits use of higher rpm motors, with savings in motor costs.

Industrial plants throughout Canada have standardized upon Gates Super HC V-Belt Drive, the 1st and most advanced high capacity drive. It is your best assurance that your power transmission units will not soon become obsolete.

Your local Gates Representative is an experienced, fully-qualified drive design expert. Contact him for drive design help.

Gates Rubber of Canada Ltd., Brantford, Ontario

X959E

Exclusive
design features
include:



precisely engineered
arched top, con-
cave sidewalls, Flex-
Weave cover, super
strength tensile
construction.

Gates Super HC
Drive saves space,
weight and money



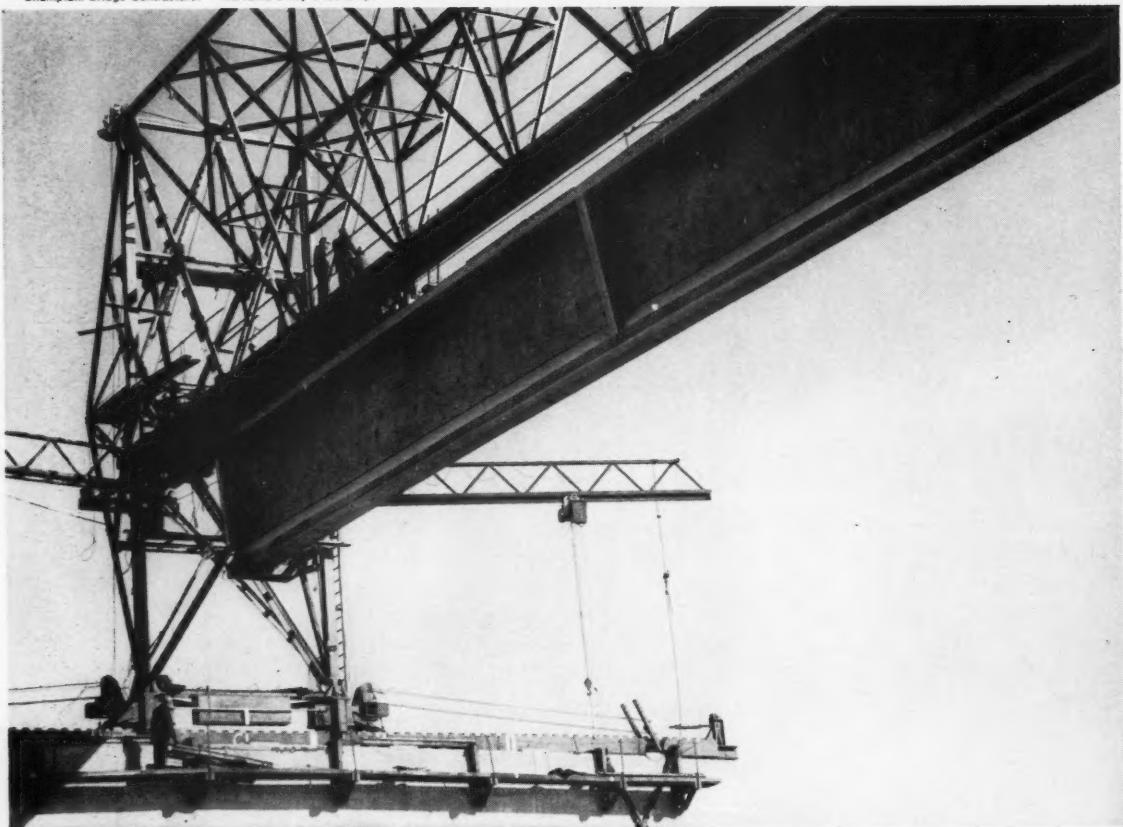
Gates
World's largest
maker of V-Belts

Gates Super HC V-Belt Drives

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HYDRAULICS BY JARRY:

Champlain Bridge Contractors: McNamara-Key-Deschamps



a solution for you, too?

The photo shows the positioning of a 176' long, 10' high, 176-ton prestressed concrete beam on Montreal's new Champlain Bridge across the St. Lawrence. Making light of this ponderous job is a hydraulic system designed especially for the job by Jarry Hydraulics Limited.

Today more and more engineers are turning to hydraulics to solve problems. We have pioneered in hydraulics in Canada with equipment on every aircraft built in Canada since 1950. If you have an idea you'd like us to help you explore, write or phone the Sales Manager of our Industrial Division.

There are interesting openings in our Engineering Department.
Write: Vice President, Engineering.

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JARRY
HYDRAULICS LTD.
MONTREAL 18, QUEBEC

Believe it or not...

THIS MAN IS CARRYING 3200 POUNDS

... 3200 pounds of permanent 'floatation' for watercraft. It's the amazing new development: VIBRATHANE 402 from Naugatuck Chemicals. And it solves a multitude of problems for boat builders . . . and others!

VIBRATHANE 402 becomes part of the structure it serves. You mix and mold it on the job . . . without any 'tricky' catalyst. Simply add 11 parts of compound 'A' to 10 parts of compound 'B' . . . Pour in the mixture where you want it . . . Then let it foam, fill and bond permanently. The whole unit becomes stronger, more rigid, and of course much more buoyant.

Versatile VIBRATHANE 402 is also finding major uses as insulation (in refrigerators and freezers, for examples) and as packaging . . . particularly where its inherent structural strength results in important design economies.

You owe it to your balance sheet to investigate VIBRATHANE 402. Mail the coupon below for ALL the facts today!



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DIVISION OF DOMINION RUBBER COMPANY LIMITED

MR. J. C. E. FULLER,
PLASTIC RESINS SALES MGR.,
NAUGATUCK CHEMICALS,
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Please rush me complete data on VIBRATHANE 402.

NAME: _____

FIRM: _____

ADDRESS: _____ PROV.: _____



Smallest, Fiercest of mammals, the mole-like, fractional-ounce shrew consumes several times its own weight of insects daily — may even kill and eat mice many times its own size. In fact, this little lightweight is so formidable that its name has been adapted to classify certain human traits; for example, "shrewish" and "shrewd".

Ideal For Missiles and other space-saving applications, this tiny rotary actuator meets military specifications for high speed torque. Measuring $2\frac{1}{8}'' \times 2\frac{1}{4}'' \times 1\frac{1}{8}''$ it is 50% smaller, weighs 50% less, than its predecessor. MPB bearings, first selected as shaft supports for special models, proved so satisfactory that they are now specified on standard models.

Man With Miracles. Like all MPB Sales Engineers, Ray Sparks has had considerable experience in helping designers choose exactly the right MPB bearings for best results in miniaturization or in instrumentation—or in both. He is well qualified to bring expert advice to your own product development and solution of problems in these fields.

Miracles in Instrumentation



ACTUAL SIZE OF THE MPB BEARINGS
IN ACTUATOR SHOWN ABOVE

Specialized customer service is one of the most valued features of MPB engineering. In addition to developing new precision bearings for miniature and precision applications, the news-making MPB Technical Center at Keene provides customers with constant teamwork in the development of modern mechanisms. For details about MPB service—and for a catalog on MPB bearings, the world's largest line — write today to **Lyman Tube and Bearings, Ltd.**, 5420 Pare Street, Montreal. Additional offices: Toronto, London, Winnipeg, Vancouver, and New Glasgow.

MPB Helps you perform
miracles in instrumentation

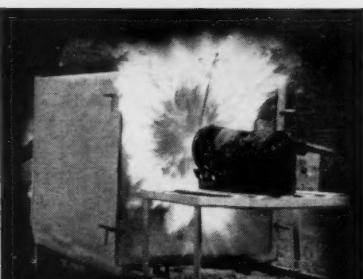
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WHEN YOU NEED RESILIENCE PLUS...



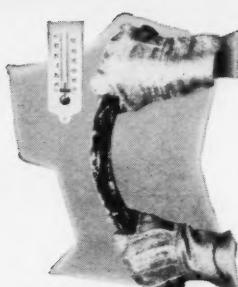
RESISTANCE TO HEAT

A million tons of hot coke have not harmed this neoprene belt.



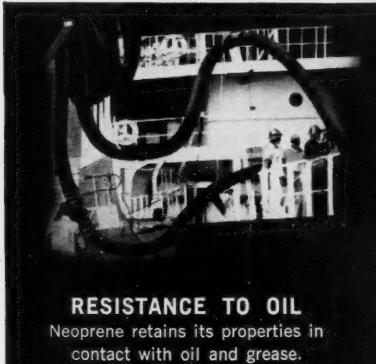
RESISTANCE TO FLAME

Neoprene coated firewalls for aircraft pass this flame thrower test.



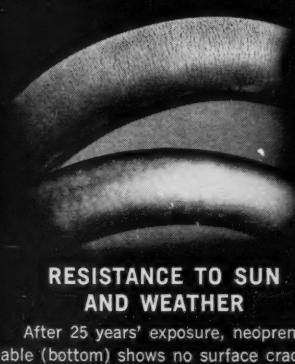
RESISTANCE TO COLD

Neoprene remains flexible even at -65° F.



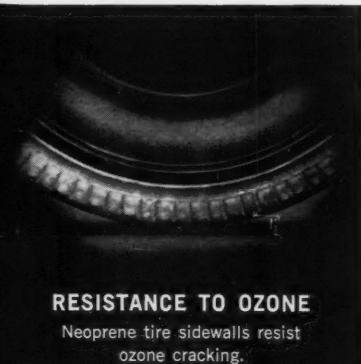
RESISTANCE TO OIL

Neoprene retains its properties in contact with oil and grease.



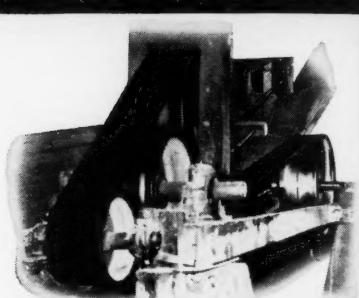
RESISTANCE TO SUN AND WEATHER

After 25 years' exposure, neoprene cable (bottom) shows no surface cracking.



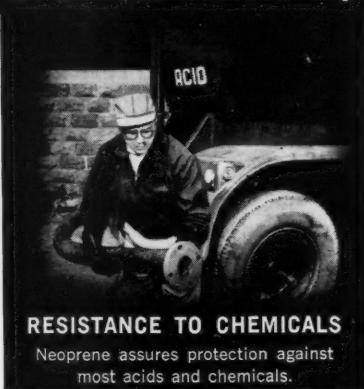
RESISTANCE TO OZONE

Neoprene tire sidewalls resist ozone cracking.



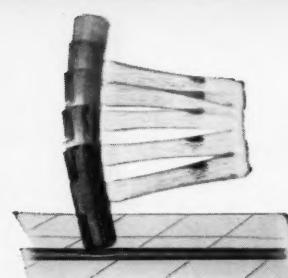
RESISTANCE TO ABRASION

Tough neoprene gives dependable service in severe applications.



RESISTANCE TO CHEMICALS

Neoprene assures protection against most acids and chemicals.



RESISTANCE TO IMPACT

Neoprene has outstanding resilience, resists permanent distortion.

SPECIFY VERSATILE DU PONT NEOPRENE

synthetic rubber

A quarter century of industrial service has proven that versatile Du Pont neoprene, with this balanced combination of properties, can meet a range of severe service requirements. Neoprene products are avail-

able from rubber goods manufacturers and distributors. For additional information, and your regular copy of "Elastomers Notebook", write Du Pont of Canada Limited, 85 Eglinton Ave. E., Toronto 12, Ont.



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DESIGN ENGINEERING MARCH 1961



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HYPALON®
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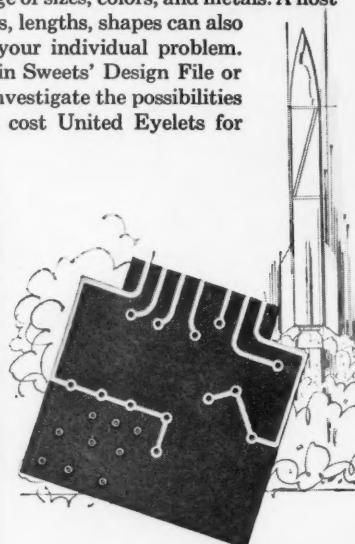
*Lowest Cost
Fastener
You can buy*



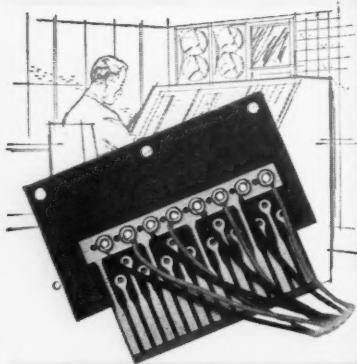
High speed fastening of 2 eyelets simultaneously cuts costs on automotive ignition breaker point assembly.



Eyelet does double duty as fastener for wind shield, bearing for spark wheel. Does both jobs well for only a fraction of a cent.



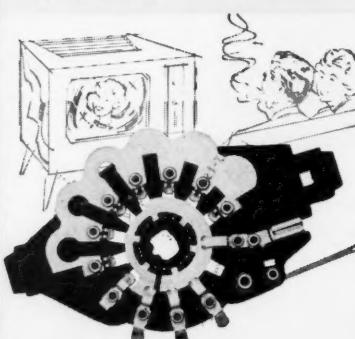
For high altitude or on the ground, funnel flange eyelets provide positive means for making reliable thru-connections on two-sided printed wiring boards.



JUST plug it in — United Standardized eyelets hold wires by compression on multi-contact computer part. Tight hold eliminates soldering time and bulk.



Before you say "hello", eyelets are working for you on our most popular method of communication. Try them on a new application — perhaps they'll prove as indispensable as your telephone.



You can avoid the inevitable commercial with the T.V. Selector Switch and still enjoy the silent utility and performance of eyelets on the switch itself.

Free Eyelet Slide Selector helps determine which eyelet you need with given grip and hole diameter.

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INDUSTRIAL SALES DIVISION
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SKINNER provides
custom flexibility
in standard
solenoid valves



Versatile, top quality V5, X5 line offers wide range of options

Skinner's two-way and three-way V5, X5 series of solenoid valves has earned the description—"The Universal Line." With more than 100,000 variations possible, V5, X5 valves are available for every conceivable application. And top quality is emphasized with bubbletight sealing, and stainless steel body, plunger and sleeve assembly. Precision machining, unique welding techniques, specially designed and developed machinery and manufacturing methods are all used by Skinner to produce the best valves made. These valves are small, yet handle operating pressures as high as 3000 psi. They accommodate all media that do not corrode stainless steel. And no other solenoid valves offer so many optional features. Check the following options.

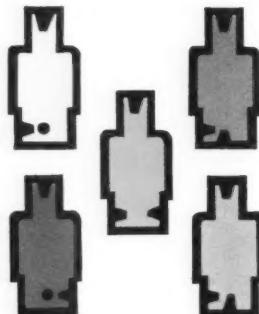


PORTING

Restrictions of installation or application, and mounting are minimized because Skinner provides a wide variety of port location options. V5, X5 valves are available with ports at right or left angles, on bottom, top, and sides for virtually all combinations of flow.

FLOW CONTROL

Precise, accurate control of media flow is possible with all Skinner V5, X5 valves. Both two-way and three-way valves are available with adjustable flow in the main stream, and with manual override. Two-way valves are also available with adjustable bypass. Exhaust flow can be controlled in three-way valves.



COILS

Skinner V5, X5 valves are available with coils of many types for most DC and AC voltages at 25, 50 and 60 cycle frequencies. Whether your requirements are for continuous or intermittent performance, in tropical, high moisture or high temperature environments, or for dual voltage, Skinner UL approved coils are available with leads of several types and lengths.



When you specify solenoid valves, specify Skinner. Skinner solenoid valves are distributed internationally.



ELECTRICAL HOUSINGS

Skinner offers an electrical housing for any application. Some of the most common are:

- standard $\frac{1}{2}$ " NPT conduit
- grommet outlet
- single or double automotive terminals
- JIC housings with integral junction box
- AN connector for military applications
- strain relief connector for quick disconnect

All housings are steel, plated for wear and appearance, and can be rotated 360° for easy installation.

MOUNTING

Skinner V5, X5 valves are provided with tapped holes for normal mounting, with mounting brackets for panel or other surface, or with flange for direct mounting without threaded pipe connections.

The Skinner V5, X5 series of two-way and three-way solenoid valves provides top quality design with orifices from $\frac{1}{32}$ " to $\frac{1}{8}$ " diameter, normally open, normally closed, dual purpose, directional control and multi-purpose, in standard and explosion-proof construction. Also included in this line is a three-way quick-exhaust type which is designed with an additional port to exhaust cylinders 4 times faster than standard types.

• • •

Typical applications—machine tools, cylinder control, instrumentation and automation of all kinds, laundry equipment, aircraft and missiles, etc. For catalogs and complete information contact a Skinner Distributor listed in the Yellow Pages or write us at the address below.



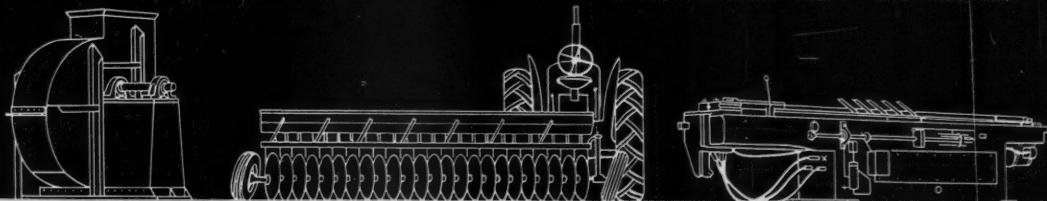
SKINNER ELECTRIC VALVES

THE CREST OF QUALITY THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT, U.S.A.

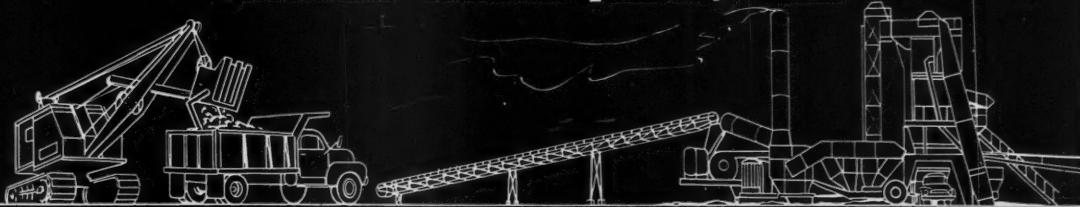
SKINNER ELECTRIC VALVE DIVISION,

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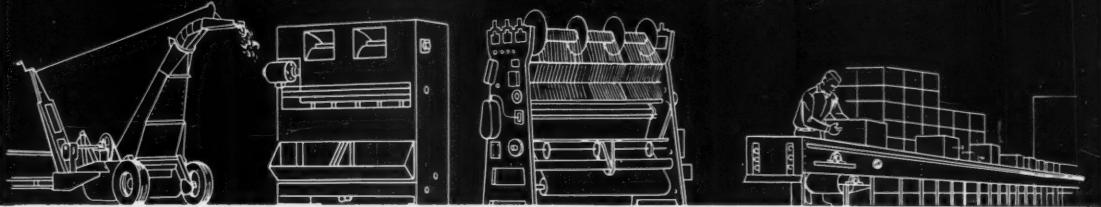
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provide added quality and



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SEALMASTER Ball Bearing Units give a decided quality advantage at no premium in price. Exclusive SEALMASTER engineering features are designed to provide years of efficient performance. SEALMASTER'S diversified lines of bearing units enables you to meet all types of bearing applications and specific mounting arrangements. Whatever your bearing requirements may be, with regard to quality, performance, load or economy, you'll find SEALMASTER has it. For full information on SEALMASTER Ball Bearing Units, including the new low cost "L" Series Units and "L" Series Units with contact seals, call your SEALMASTER factory sales representative or distributor, or write direct to the factory.



Normal-Standard-Medium Duty
PILLOW BLOCKS



Standard-Medium Duty
FLANGE UNITS



FLANGE CARTRIDGE
UNIT



LP PILLOW BLOCK



WRITE FOR
CATALOG 454
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LF FLANGE UNIT



SEALMASTER BEARINGS A division of
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LINK-BELT HELICAL GEAR SPEED REDUCERS



3-of-a-kind for versatility

GEARMOTOR

perfect choice for close quarters

Where inches count, here's your best choice for high-efficiency speed reduction. Simple gear trains and flange-connected motor combine for exceptional compactness. The flange connection eliminates additional coupling devices . . . assures positive, permanent motor alignment. Available in double, triple and quadruple reductions. Ask for book 2747.

MOTOGEAR

no delays in motor replacement

Motor switching takes just minutes with Link-Belt Moto-gears. They're designed for bracket-mounting, foot-type motors of *any enclosure, any make!* No need to drain oil. And no realignment problems—the rigid bracket automatically assures accurate positioning. Other features: oil-tight cast iron housing; hardened gears; straddle-mounted pinion that easily withstands shock, reversing or heavy loads. Available in double, triple and quadruple reductions. Ask for book 2747.

IN-LINE

mount the motor anywhere you want it

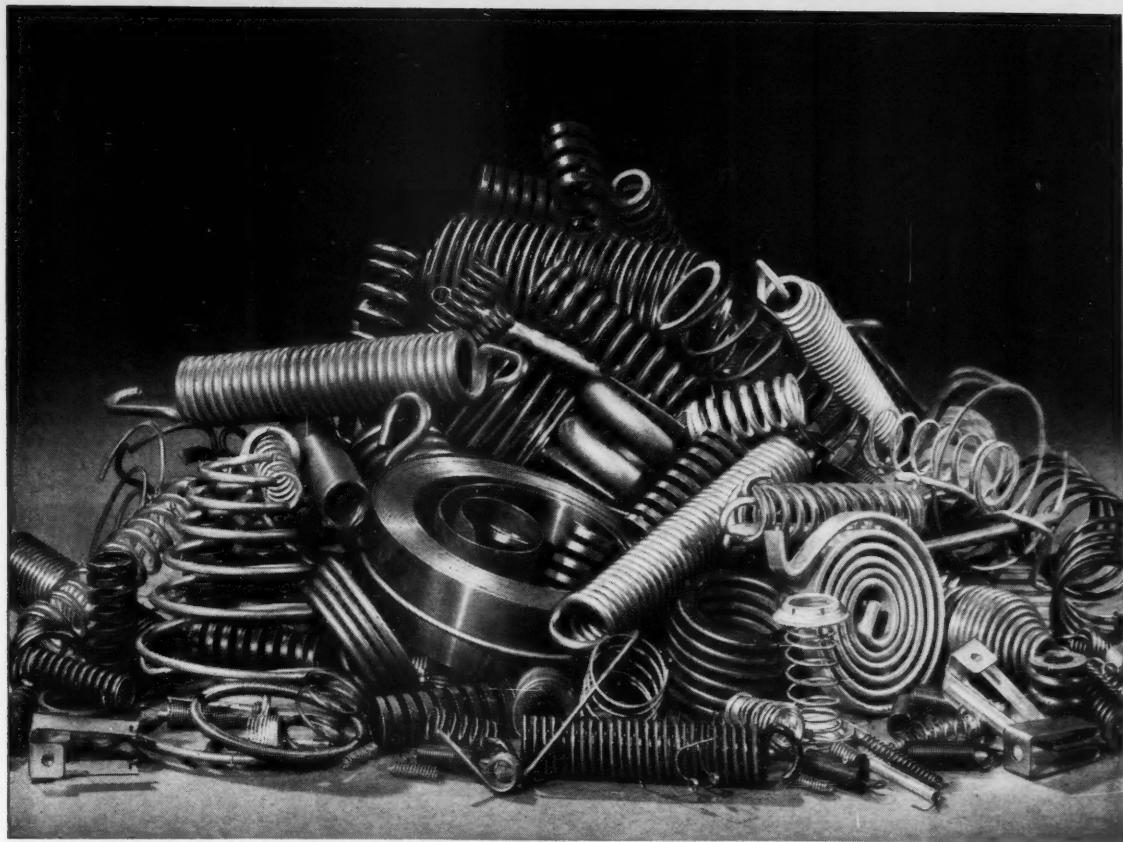
Your choice of drive arrangements is practically limitless with a Link-Belt In-Line. You can mount the motor anywhere . . . it needn't be direct-connected. Input and output shafts are on the same horizontal and vertical planes . . . offer maximum flexibility to meet layout and space requirements. In-Lines feature the simplest of gear arrangements . . . encased in sturdy, well-sealed, one-piece housings. Available in double, triple and quadruple reductions. Ask for book 2751.

ASK OUR ENGINEERS! Our experienced field engineers will help you with your application problems. With industry's *most complete* speed reducer line to work with, their recommendations are unrestricted, unbiased. Contact your nearest Link-Belt office or authorized distributor. Ask for the catalogs listed above.

LINK-BELT

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needle in a haystack?

Finding just the right spring can be costly and time-consuming. Even though springs look alike, each is different—depending on the job it has to do. Type, size, tension, temper, stress, and other complicating factors must be considered in their design and manufacture.

If finding the right spring for your problem seems like "looking for a needle in a hay-

stack," Wallace Barnes can help you. Our spring engineers are ready to accept your precision mechanical spring problem and help design the *right* spring to do your job precisely right.

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Selecting the right spring is simple . . .

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Many years ago, a German psychologist, a Professor Ebbinghaus, measured how quickly and easily people forget things. The same general findings have been substantiated by scientists since.

... by the end of the day you forget over a third.
... by the end of the week you forget over a half.
... by the end of the month you've forgotten two-thirds.

This points up a major benefit of business paper advertising. It not only gets your message straight to the people who specify and buy but it also makes it

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Even when your salesmen are out of sight, your company and its products are not out of mind when you advertise consistently in business newspapers.

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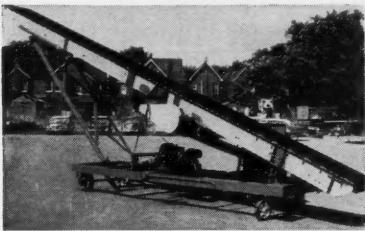


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GET YOUR MESSAGE THROUGH CLOSED DOORS TO PEOPLE WHO SPECIFY AND BUY

ALBION CASTER NEWS

IDEAS THAT MAY BE HELPFUL TO YOU — PRESENTED BY YOUR ALBION DISTRIBUTOR



HOW TO MAKE A PORTABLE CONVEYOR STAY PUT — Easily done with firm gripping Albion toe-operated wheel brakes fitted to rugged Albion "TT" Casters as used on this portable conveyor for handling bagged sugar. **No. 61201.**



**High Capacity
Albion Caster
For Slow-Moving
Equipment**

Designed for high capacity, slow speed requirements, this Series 91 Super Duty Caster has a capacity of 8,000 pounds when equipped with Timken bearings or 4,000 to 6,000 pounds with Hyatt type bearings. Drop-forged steel wheels for use on this caster are available in sizes from 6" to 10" diameter, 2½" to 3" width. **No. 61202.**

**Albion Caster
With 101 (or more)
practical uses**



For special attachment problems, an angle iron bracket can easily be welded to the forged steel top plate. This provides a simple, economical solution for attaching casters to benches, scaffolding, racks, etc. Albion casters more than meet your requirements for all phases of service . . . and price. **No. 61203.**

WANT MORE DETAILS?

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UNITED STEEL CORPORATION LIMITED,
58 Pelham Avenue, Toronto 9

No. 61201 No. 61202 No. 61203
 No. 61204 No. 61205

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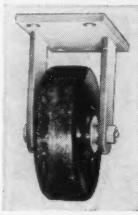
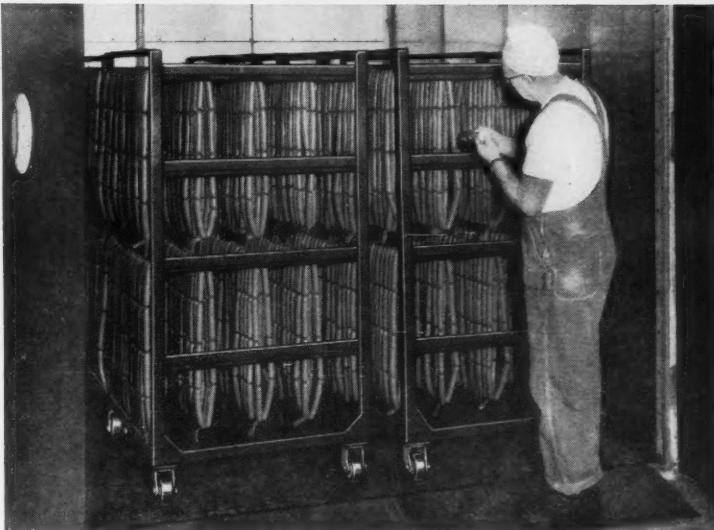
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NEW SANITARY CASTER RUNS CLEAN—STAYS CLEAN—MEETS INDUSTRY CODES



THE NEW ALBION
SANITARY CASTER

A complete line of Albion sealed sanitary casters, developed specifically for food handling and processing plants, hospitals, pharmaceutical houses and other places where cleanliness is essential.

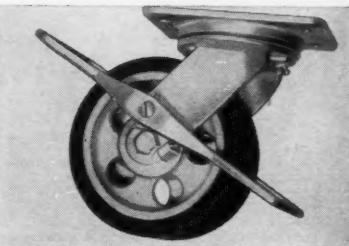
The unique new design of these casters makes sanitary maintenance simple and easy. The need for periodic lubrication due to grease loss or entry of foreign matter has been eliminated.

All Albion Sanitary Casters are supplied with straight-sided, molded Texite wheels. Texite wheels combine high capacity with the advantages of better floor protection. Albion Sanitary Casters resist mild acids, operate perfectly in almost any temperature range and remain clean, smooth and sanitary. **No. 61204.**

YOUR LOCAL ALBION DISTRIBUTOR OFFERS FAST, ONE-SOURCE SERVICE

He's a materials handling expert with the right Albion caster for your mobile equipment needs . . . probably available in stock. You'll find him listed under "CASTERS" in the Yellow Pages. Call him with confidence for the finest service.

NEW TREAD OUTWEARS RUBBER UP TO 5-TO-1

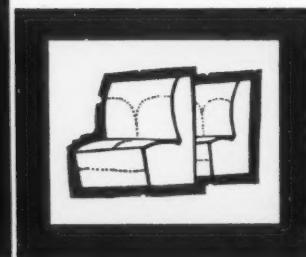
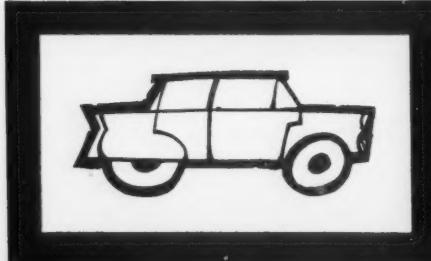
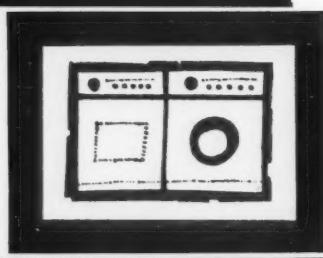
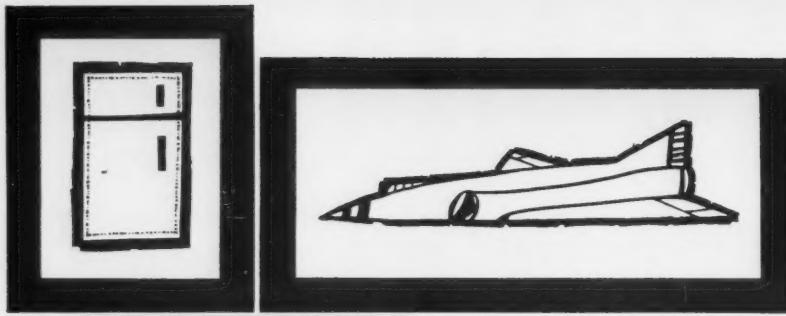


Alathane is the name of a new polyurethane elastomer material that has the load-carrying capacity of steel wheels plus floor protecting qualities, quietness and resilience. Alathane wheels have many times the abrasion-resistance of rubber or plastic wheels and are chemically inert, non-sparking, non-conductive and noiseless. 6" to 12" wheel diameters — swivel or rigid casters. **No. 61205.**

Albion Caster Division

60-120
United Steel
CORPORATION LIMITED

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SUPER NUELITE

An Acrylic type finish designed for chemical and heat resistance. High quality bake enamel for appliances.

NUELITE

A quality Alkyd-Amyne finish for appliance industry.

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Epoxy type finish for use where excellent chemical resistance is required. Used for product finishes, industrial maintenance, pipe-line coatings, and linings for tanks, pipes, drums, etc.

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Multiple coat system for use on marine installations, ships, and generally where extreme acid and alkali resistance is required.

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GLIDPOL

Polyester resins for electrical, marine and general use. Rigid and flexible foams for insulation and cushioning.

GEL-KOTE

Used for colored, smooth finishes for polyester mouldings and laminates.

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A new development—that gives a "tile-like" finish over concrete, brick, etc. at 1/3-1/2 the cost of ceramic tile.

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Corrosion resistant metal primers and finishes.

LACQUERS

A complete range for the wood and metal industry.

WIRE ENAMELS

Insulation varnishes and cable coatings for the electrical industry.

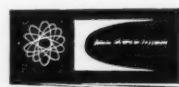
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March 1961

Designing for chemical welding

Part 2

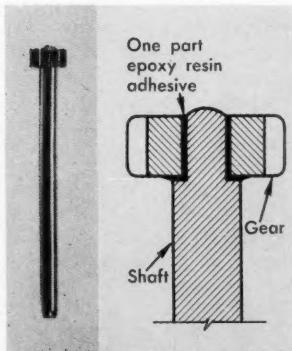
Joint design

H. J. Jankowski of Minnesota Mining & Manufacturing continues his three-part series. The first article appeared in January.

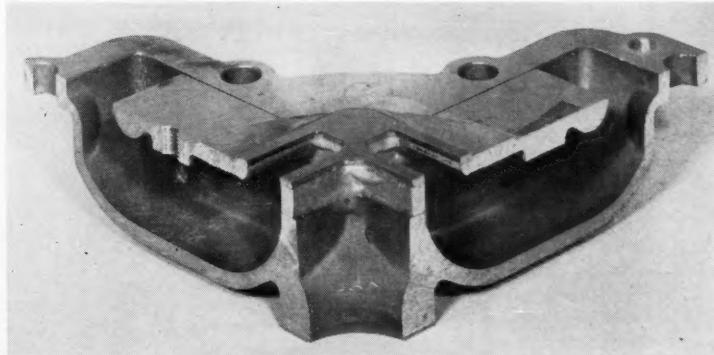
The use of load-bearing adhesives was pioneered by the aircraft industry. They have helped make possible for instance the increase in life expectancy of helicopter rotor blades from 90 hours with riveted assembly, to 1200 hours with adhesive assembly. They have demonstrated, over the past few years, their strength, resistance to fatigue, feasibility in production and reliability.

Certainly, if structural adhesives are used to advantage in assembling multi-million dollar, high-speed aircraft, they can also be used to advantage in load-bearing applications in many other industries.

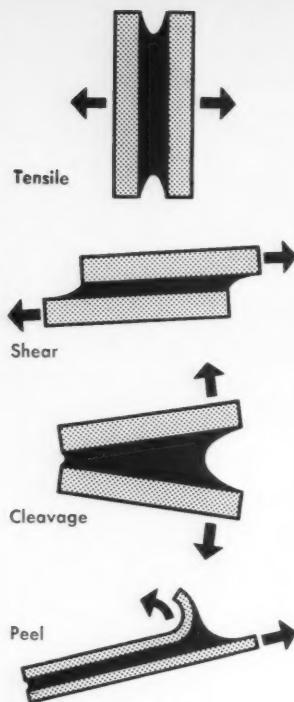
High-strength phenolic elastomers and epoxy-resin adhesives are being used to an increasing extent for the structural joining of aluminum, brass, magnesium, steel, stainless steel, titanium and copper. High-strength adhesives allow the engineer to design stronger, more eye-appealing, more fatigue-resistant



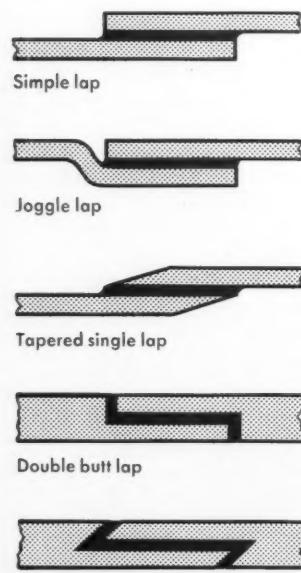
Bonding small pinion gear to shaft reduced production rejects.



Three separate die castings are bonded together to make one complete part. When the part was cast in one piece, blowholes often occurred because of complex design.



The four basic types of stress encountered in structural bonding illustrate the first fundamental of joint design.



In adhesive joint design the shear or lap joint is the one most generally used.

joints with thinner, lighter metals. In assemblies of thin sheets, the bond strength of the adhesive often exceeds that of the metal itself.

Selecting the right adhesive

The important matter of selecting the right adhesive for each type of service is not a simple procedure. There is a great variety of adhesive products.

Applications should be studied to determine which properties and conditions are most important and limiting. In many cases two or more adhesives should be considered. Sample bonds should then be taken and exposed to actual or simulated service conditions, and tested to determine actual bond strengths.

Parts to be bonded should be designed to take full advantage of the desired properties in selected adhesives. Adhesives seldom display their best properties when substituted directly for other fastenings.

An adhesive joint derives its strength from using a larger contact area than joints of other types. Ideally, the whole joint is stressed if it is properly designed. Enough faying surface area must be designed into the joint to produce the required strength. If it is not possible to design for the best joint geometry, then an adhesive should be selected which performs best under the type of stress to be encountered.

The adhesive that produces the strongest bond in tensile or shear will not, necessarily, produce the highest strength in peel.

In tensile or shear loading, the more rigid adhesive offers the greatest strength. However, if the joint will be required to flex or will be subjected to vibration or shock loads, then some compromise in ultimate strength must be made to provide a degree of resiliency to withstand the dynamic loading.

Peel-loaded joints are stronger when the adhesive has some elasticity. A brittle adhesive fractures readily and the joint fails progressively as stress is applied. Elastic adhesives are superior in peel, because, in stretching under stress, they tend to widen the line along the load-carrying edge. This distributes load over a greater area.

Expansion coefficient problem

Greatly differing coefficients of expansion of dissimilar metals can present a problem, particularly if the adhesive to be used is not sufficiently elastic. A brittle adhesive develops great internal stresses as changes in temperature occur. These stresses can become great enough to destroy the bond itself or cause warping in the assembly.

Some adhesives will take great loads of short duration, but fail progressively when stressed under conditions of dead loads. Such adhesives slowly creep when constantly stressed for long periods of time. Rigid adhesives are better for dead load conditions.

Service conditions also narrow the choice of adhesives. Service temperature range is one of these factors. Many adhesives will perform at low temperatures in the vicinity of -65°F. At the other extreme, 180°F is a common limit. The modified epoxies and phenolic-elastomers maintain appreciable strength up to service temperatures of 500°F. Much work is being done today to force the limit upward to keep pace with advanced design.

Some modified epoxy-resin adhesives have room temperature shear strengths up to 5,000 psi, although 3,500 psi is a more representative figure for commercially available products.

Exposure to solvents, chemicals, fuels and other deteriorating media are often a part of service requirements. Adhesives with resistance to most solvents and chemicals are available. Resistance to all media cannot be found in any one adhesive. Some are completely inert; others are not seriously enough affected to impair their usefulness.

Design is largely common sense

Like most design concepts, designing for the proper use of structural adhesives is largely a matter of common sense and experience.

There are two fundamentals that have a direct relationship to joint design. First, all structural joints should be designed so that all of the bonded area is carrying the load at the same time; second, the joint configuration should be so designed that the basic stress is in shear or tensile, while cleavage and peel stresses are minimized.

In an ideal tensile loaded joint, the forces are perpendicular to the plane of the joint and the stress is distributed uniformly over the entire bonded area. The entire joint is under equal stress at the same moment and all of the adhesive contributes to the strength of the joint.

In an ideal shear loaded joint, the forces are parallel to the plane of the joint and again stress is distributed uniformly over the entire bonded area. All

of the adhesive is at work at the same time to provide maximum joint strength. This type of joint is more frequently used than the tensile loaded joint because it is more easily fabricated.

When a joint is stressed in cleavage, the forces are not distributed uniformly over the entire bonded area, but rather all of the stress is concentrated on only a small portion of the adhesive. As force is applied, one edge is under no load at all. The cleavage loaded joint is much weaker than a joint of the same area under tensile or shear loading, and should be avoided in joint design.

In a bond subjected to peel stress, the stress is confined to only a very thin line at the edge of the bond. Here, only a fraction of the total bonded area is being used and even less adhesive is contributing to the strength of the joint than in the cleavage loaded joint. Even more than cleavage, this type of stress should be avoided in adhesive joint design. Therefore, it is advisable to design joints for tensile and shear loading conditions and minimize or eliminate cleavage or peel stress from the design configuration.

Joint design more complicated

Joint design, however, is usually more complicated than indicated thus far. Rarely, if ever, will a joint be subjected to stress in only one direction. In practice there is usually a combination of several different types of stress. In some cases, distortion of adherence under load will introduce secondary stresses.

In adhesive joint design, the shear or lap joint is the one most generally used. Also, lap joints are the most practical and applicable to adhesive bonding of thin materials.

Because of the off-set nature of a simple lap joint, shear forces are not in line. This can result in the introduction of cleavage and peel stresses under tension. Under moderate load, distortion of the joint occurs because the bonded area will pivot normal to the load. At this point an element of cleavage is introduced.

When an extreme load is applied, such that definite bending of the metal at the edges of the bond occurs, then peel stresses are introduced into the joint. The type of metal to be bonded influences this tendency to distort. A soft metal distorts under a lower load than a tempered metal. This gives an apparent lower bond strength.

In cases such as this, the second fundamental in adhesive joint design should be applied, namely the configuration of the joint should be redesigned for maximum strength. Three design alternatives are open to increase performance:

- The joint can be redesigned to bring the tension load on the adherends in line.
- The edges of the bond area can be tapered to provide a better length to thickness ratio, thus minimizing peel stresses.
- The adherends can be made more rigid near the bond area to minimize cleavage.

Many joint designs

The joggle lap joint is the most practical. It places the entire load-bearing area in the same plane as the shear stresses on the adherends. In this type of joint, application of pressure for curing is easily accomplished and the joint can be formed by simple metal forming operations.

A tapered single lap joint is more efficient than a single lap joint. The tapered edge allows bending of the joint edge when distortion occurs under stress.

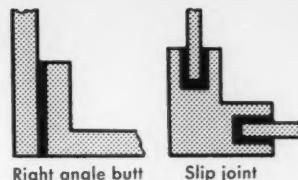
The double butt lap joint places the load-bearing area in the same plane as the shear stress on the adherends. This type of joint, however, requires machining which is not always feasible with thinner gauge metals.

Double scarf lap joints have better resistance to bending forces than double butt joints. This type of joint, however, also requires machining.

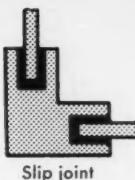
There are at least six other joint designs possible. The above mentioned adhesive joint designs are the most generally used. Also, lap joints are the most practical. They are, by no means, the limit of possible adhesive bonded joints, but are mentioned only to illustrate the utilization of one or more design alternatives.

The change in the geometry of a joint can, as has been shown, upgrade adhesive performance. If an adhesive is tested for a particular application with unsatisfactory results, the program need not be abandoned at this point. A simple joint design change may be the answer. This is one reason why adhesive manufacturers like Minnesota Mining and Manufacturing of Canada Ltd. appreciate being consulted while a problem is in the design stage.

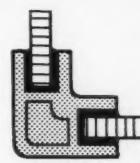
To be continued in the May issue of Design Engineering



Right angle butt

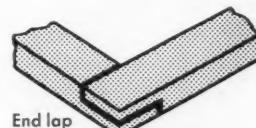


Slip joint



Right angle support

Corner joints in thin metal can be assembled with adhesives by using simple supplementary attachments.



End lap

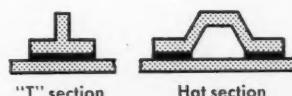


Mortise and tenon



Mitered joint with spline

Corner joints such as these in doors and windows are excellent from a design point.



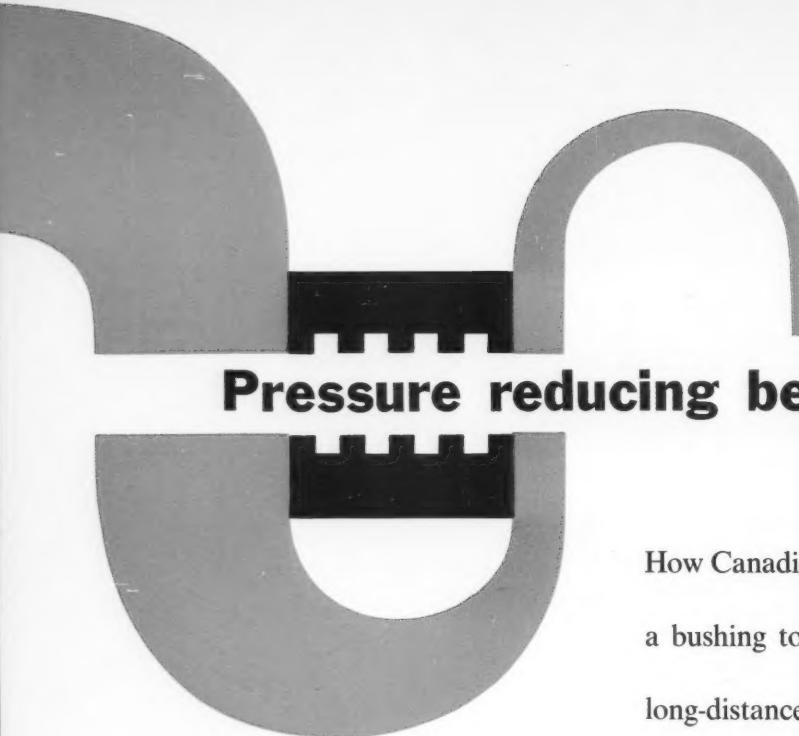
"T" section

Hat section



Corrugated backing

Deflection and flutter of thin metal sheets can be minimized by adhesive bonded stiffeners.



Pressure reducing bearing design

How Canadian Allis-Chalmers developed
a bushing to give economical
long-distance pumping of 35% slurry

Transportation of solids in slurry form has always been a problem in mining and milling operations. The use of centrifugal pumps has long been recognized as an effective means of moving a water-solids mixture, but an average slurry containing 35% solids by weight, and occasionally double this concentration, is obviously an extremely efficient abrasive.

A tailings disposal problem encountered recently lead to the development of a four-stage pumping station which is believed to be the first of its kind on this continent. The slurry to be handled consisted of a solids-water mixture 32% solids by weight, 60% minus 200 mesh at a specific gravity of 1.26. This material was to be pumped at a rate of 1,100 U. S. gpm, to 1,700 U. S. gpm through 7,000 feet of line with a static lift of 230 feet, a friction head of 245 feet for a total dynamic head of approximately 475 feet or 259 lb.

The usual method would be two pumps in series at the mill site and two approximately half way along the disposal line. However, four pumps in series at the mill site offered definite advantages. A booster station at a remote location would require a pump house, gland water and power transmission lines, a service road and an operator, all of which could be eliminated by four-stage pumping.

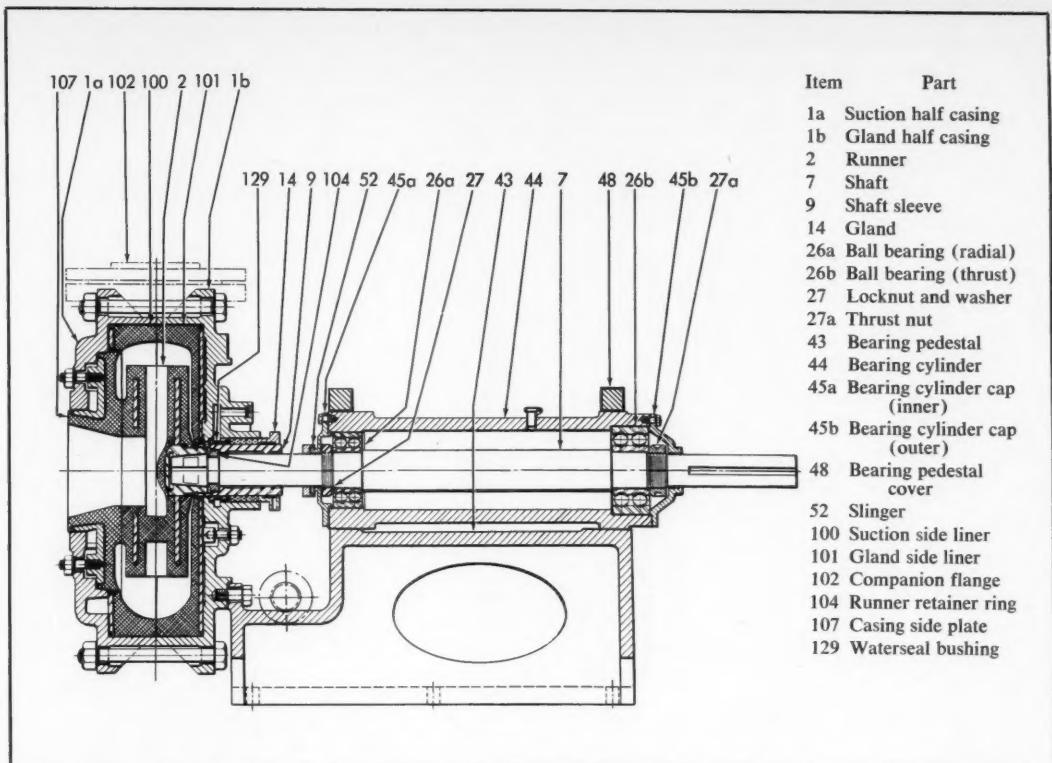
Two major problems

From the pump design perspective, four-stage pumping presents two problems: 1) design of a casing to

withstand the high working pressure and 2) design of a packing box which would seal adequately at the high pressures encountered. The former presented economic rather than engineering problems. Calculation of stresses for additional studding and ribbing to withstand high pressures is relatively straightforward. The difficulty is incorporating the necessary changes to take maximum advantage of existing patterns and tooling to maintain development costs at a minimum. This was facilitated by the use of ductile iron for the casing material, which provided sufficient strength while permitting the use of existing patterns with modifications.

Design of packing box

Design of the packing box was a different matter. The fourth stage box would have close to full discharge pressure of 259 lb. on the packing if the standard design was used. Experience has shown that while packing can be used on rotating pump shafts to seal pressures up to the order of 175 lb., behavior over 100 psi is erratic since successful operation depends on the packing used, peripheral speed of the shaft, skill of the operator in packing the box, and other variables. For this reason it was felt that the actual pressure on the packing should be maintained under 100 psi. To accomplish this it was decided to utilize a pressure reducing labyrinth, flushed by clean water, between the packing and the pump. Design of this labyrinth was based on previous tests and design criteria established in conjunction with work by Allis-Chalmers on leakage



1. Typical sectional arrangement of a closed impeller rubberlined pump for handling a slurry with a large proportion of solids.

in high pressure boiler feed pumps. These studies advanced the principles outlined on page 46.

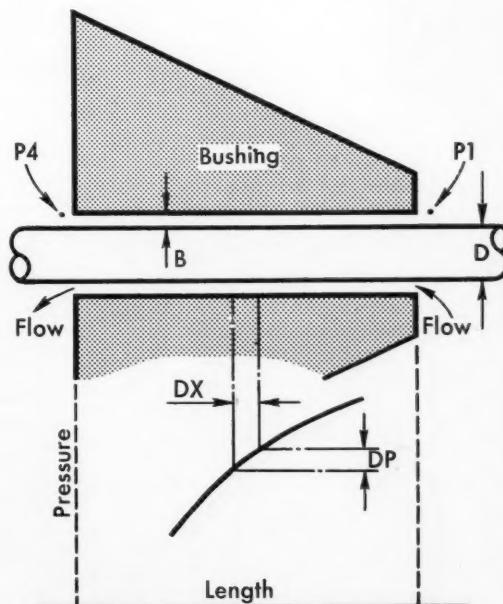
Fig. 2 shows the relationship between pressure drop and length of the bushing.

Referring to the chart in Fig. 3 it is important to note that the pressure readings were taken immediately adjacent to the entrance and exit of the bushing (see Fig. 2). That is, "F" includes entrance and exit losses of this narrow annular cross-section, also the entire length of the bushing was considered as the measuring length. The tests show that the critical Reynold's number for region I, where laminar flow occurs, is 1,000 compared with approximately 2,500 for the standard pipe cross section. In this range surface ridges lie completely within the laminar boundary layer. In region II, Reynold's number 2,500 to 4,000, the thickness of the laminar boundary layer is approximately the same as the height of surface roughness. As the Reynold's number increases, more ridges project through the boundary layer, increasing flow resistance, until full turbulent flow is reached in region III, Reynold's numbers over 4,000. The Allis-Chalmers test results (conducted with cold water) coincided with the test results of J. H. Keenan (conducted with steam and water) in the same region so both were used in determining "F" for Reynold's numbers from 3,000 to 1,200,000.

Other test results

Further tests showed that:

- Where either the bushing or the rotating shaft are serrated (Fig. 4) there is 20% to 25% less leakage



2. Diagram showing points at which pressure readings were taken and relation of pressure drop along the bushing.

Design principles advanced by pump leakage tests

Nomenclature and formulae

P = pressure.....	lb per sq ft
H = pressure.....	feet of water
D = diameter.....	inches
g = acceleration of gravity ..	feet per sec ²
W = fluid specific weight.....	lb per cu ft
L = length.....	inches
V = velocity.....	feet per sec
B = radial clearance.....	inches
v = kinematic viscosity.....	feet ² per sec
G = mass flow.....	lb per sec
A = cross sectional area.....	sq ft
F = friction coefficient	—
dP_f = pressure differential due to frictional resistance...	lb per sq ft
α = specific volume.....	cu ft per lb
m = means hydraulic radius..	feet

Condition of continuity and equation of motion:

$$G\alpha = A \quad \dots \quad (1)$$

$$d\left(\frac{V^2}{2g}\right) = -\alpha(dP - dP_f) \quad \dots \quad (2)$$

where $(dP - dP_f)$ represents the pressure drop necessary to accelerate the fluid. α is a constant for an incompressible fluid and following equation (1), the velocity is also a constant so that according to equation (2)—

$$dp = dp_f \quad \dots \quad (3)$$

which shows that " dP_f " is identical with the pressure drop measured in an incompressible fluid. For an incompressible fluid the following general formula applies:

$$\Delta P = -4F\left(\frac{L}{D}\right)\left(\frac{W}{2}\right)\left(\frac{V^2}{29}\right) \quad \dots \quad (4)$$

where "F" is a function of the relative roughness of the wall surfaces and Reynold's number—

$$\text{Re. No.} = \frac{VD}{v} \quad \dots \quad (5)$$

where:

$$D = 4m = 4\left(\frac{\text{cross sectional area}}{\text{wetted perimeter}}\right) \quad (6)$$

$$4m = \frac{\pi\left(D + \frac{B}{12}\right)\frac{B}{12}}{\pi D + \pi\left(D + \frac{2B}{12}\right)} = \frac{B}{6} \quad (7)$$

therefore:

$$\text{Re. No.} = \frac{VB}{6v} \quad \dots \quad (8)$$

than in a straight bushing and shaft.

2. If both the bushing and rotating shaft are serrated leakage is less than with a single serrated number but the reduction is slight.

3. The serrations to reduce leakage should be deep but not too long otherwise the effect is lost and there is no leakage reduction.

When designing a pump for high pressure service, it is desirable (for economic and manufacturing reasons) to utilize as many components as possible from existing developments. It is evident that if a pressure reducing bushing is placed at the pump end of the packing box it will be necessary to increase the distance between the casing and impeller centreline and the pump end bearing. An increase in this shaft overhang, assuming the shaft diameter is maintained constant, means additional shaft deflection through the packing box and pressure reducing bushing due to radial hydraulic loading on the impeller.

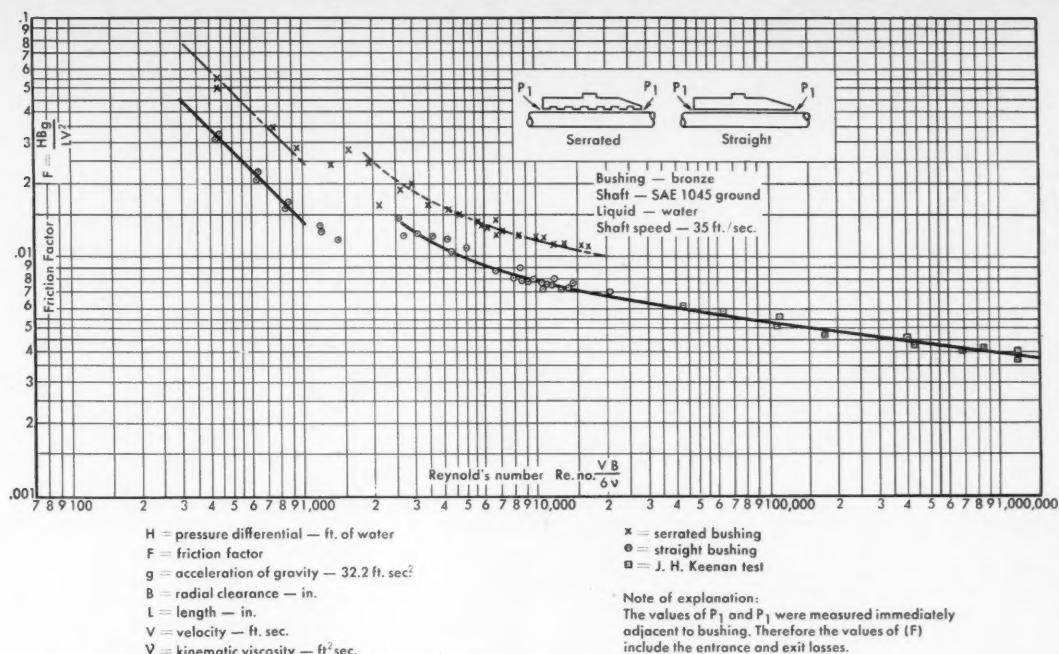
The pressure reducing bushing clearance is dictated in part by the shaft deflection through the bushing. An increase in shaft diameter and other design changes can be made to reduce deflection due to the added overhang. However, modifications in this direction are limited if the use of existing elements is to be maintained. Under these conditions, an economic compromise must be made between development and manufacturing costs and cost due to excessive leakage through the labyrinth in the final installation.

Serrated bushing best

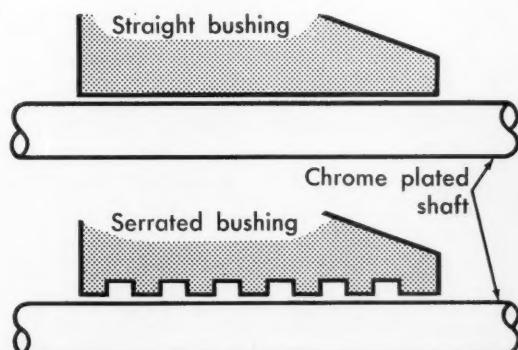
Based on results of tests, manufacturing and design considerations, it was concluded the best method of reducing pressure was the use of a smooth rotating shaft sleeve of stellite and a serrated stationary pressure reducing bushing of stellite.

Fig. 6 shows the final arrangement of the pressure reducing bushing. Solids are prevented from entering the annular space between the labyrinth bushing and the sleeve by use of filtered water supplied under pressure higher than that developed by the pump and flow through the labyrinth is controlled by a back pressure valve. While in a four-stage application of this sort, pressure regulators, flow indicators, provision for automatic shutdown and dumping of the system in the event of gland water failure, etc., played an important part in providing a dependable, safe overall installation, it is beyond the scope of this article to describe the complete gland water system in detail. Sufficient to say that a dependable supply of gland water at reasonably constant pressure is a necessity for successful operation.

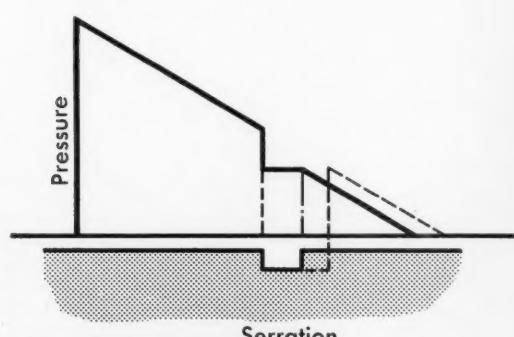
Although the first four-stage installation encountered teething problems on the initial startup, it has proved successful. In the first year of operation, over 2½ million tons of pulp was moved with trouble-free pumping. In addition, four-stage pumping saved approximately \$100,000 over the alternate method of placing one or more stations at intervals along the pipeline. Subsequent development and test work indicates improvements are possible in the initial design. A series of "floating" bushings (bushings not rigidly positioned in the packing box) are less sensitive to occasional tramp solids which may find their way into the labyrinth, permit closer clearances to be used and make possible the use of cheaper wear-resistant materials in the sealing members which can be machined rather than ground. This results in a design which can be produced at a lower cost, is more efficient, more compact, and requires less than half the sealing water of the original bushing.



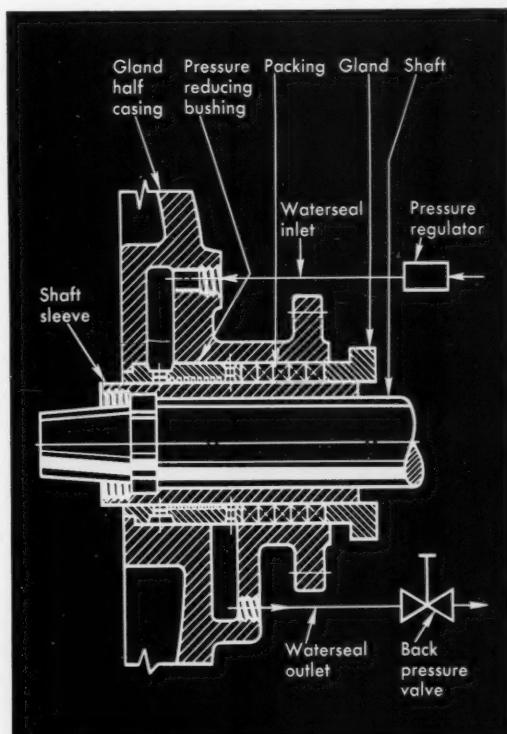
3. Relation between Reynold's number and 'F' for a rotating shaft in a bushing with close clearances.



4. Arrangements of straight and serrated bushing designs.



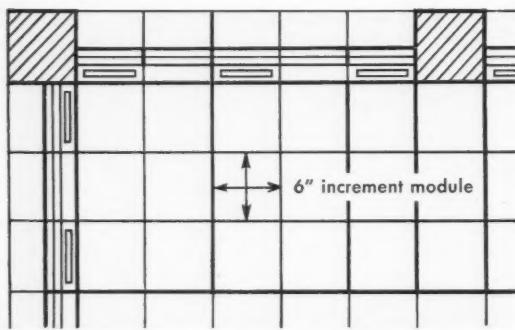
5. Graph showing the shape of the pressure drop curve of a serrated bushing.



6. Design of pressure reducing bushing finally arrived at by Canadian Allis-Chalmers.

The trend is to modules

Save time and money by designing office furniture on a standard module says Stanley R. Shefler, president of Designs for Business of Canada Limited.



Not too long ago, while planning a move to a new office building, a company was confronted with a problem when the designer recommended 40 new desks for the company's general secretarial area at a cost of about \$6,000. The client resisted the recommendation, arguing that the old desks would adequately serve this area.

It was pointed out that the new desks would require 600 sq ft less than the space required by the old desks. In this way, with space worth \$6 a square foot, there would be a saving of \$3,600 per year in rent—or \$36,000 over a 10-year lease.

Further, by using new modular L-shaped desks, a more efficient arrangement would be achieved. Great strides have been made by North American industrial designers in applying modular principles to design of a broad range of equipment and fixtures: desks, chairs, tables, shelving, trays, sofas, and even business machines.

The basic objectives of the office designer today can be realistically defined as follows:

- To establish interiors that provide maximum efficiency for current requirements and are adaptable to future expansion at minimum cost and without major construction.
- To accomplish these efficiency and economy feats within a design framework that is aesthetically sound and answers the human needs for comfort and attractive surroundings.

Challenge of the module

Dream of today's office management is a given space equipped for a lifetime of business use and

human needs. This seems a superhuman achievement. But, with effective planning, it can be realized.

Obviously, movable walls hold the key to the modular concept. Office management has begun to realize that planning an office with fixed walls is like buying your wife a lifetime supply of size 12 dresses.

Movable walls are scaled to the dimensions of the particular module used in a given office. The walls can be moved anywhere in the office to expand or contract space. And, since each module contains heat, lighting, electricity and so on, all you do to change space is reposition the walls and furniture.

The interior designer is always the beneficiary of a pre-established building module. He must therefore incorporate his work and his thinking within a set framework. A sampling of completed postwar buildings and a study of the standardization of products and materials achieved by the majority of manufacturers in the postwar period suggest that modules such as 4 ft, 4 ft 6 in. and 5 ft permit both an engineered and integrated relationship between the interior and these basic stock elements.

This does not mean that modular integration is not possible to achieve on other modules. It is possible to accomplish this—but only with the introduction of specially sized ceiling tiles, lighting fixtures and pillar pieces to take up the additional inches beyond the even dimension.

In general terms, the ideal type of structure which the designer can inherit from the architect is illustrated opposite. In this framework, the designer is able to establish a single dimensional reference or module.

The term "modular" is meaningful in office planning only when it incorporates both interchangeability and flexibility. Movable partitions, for example, may be established over a floor on a 3-ft module. But, if the ceiling and lighting is on a 4-ft module, the whole value of movable partitions is lost.

Impact on furniture design

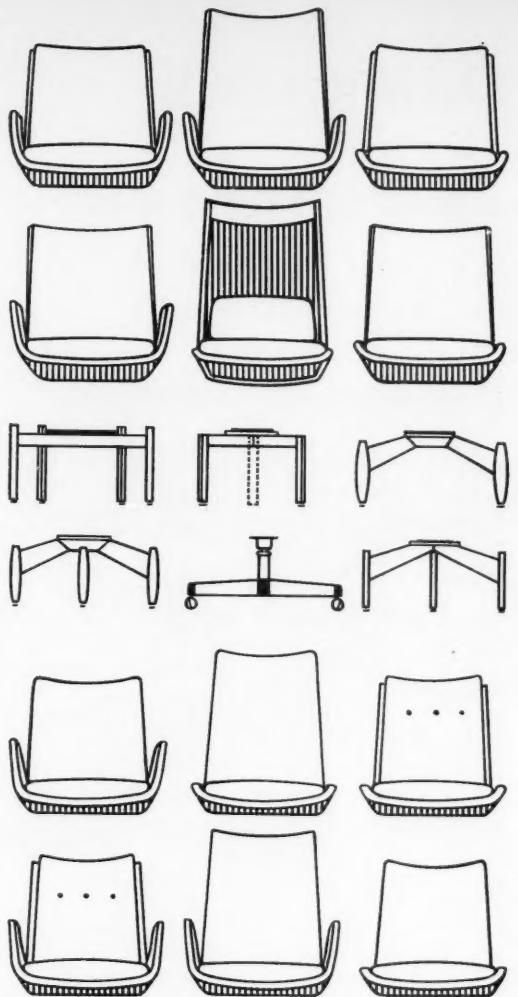
There are today many elements and materials produced by various manufacturers — flooring, cabinets, desks—which are advertised and sold as "modular" but which are not interchangeable at all. While some selected flooring tile may all be executed by a particular manufacturer on one module, it will offer no modular performance if it is combined with some ceiling or wall material manufactured by another producer on another module.

Thus far, only a modest start has been made in applying the theory of interchangeable parts to office furniture design. This stratagem would be as valuable to the manufacturer as to the office manager — combining the advantages of mass-production economy with custom-production effects. In case of office changes, there would be total salvageability of furniture.

Other advantages are ease in tooling and manufacturing through the use of a few standardized parts, efficiency in storing and filling orders—combined with the psychological and practical satisfaction of the infinite potential for variation that the user achieves.

The application of interchangeable parts to chairs is shown in fig. 2. Designer Gerald Luss has manipulated contours, proportions, angles, tilts, and upholstery to produce some of the most comfortable chairs a body might sink into.

As indicated by the drawings, there are two sizes of container shells—a higher, larger one for the lounge



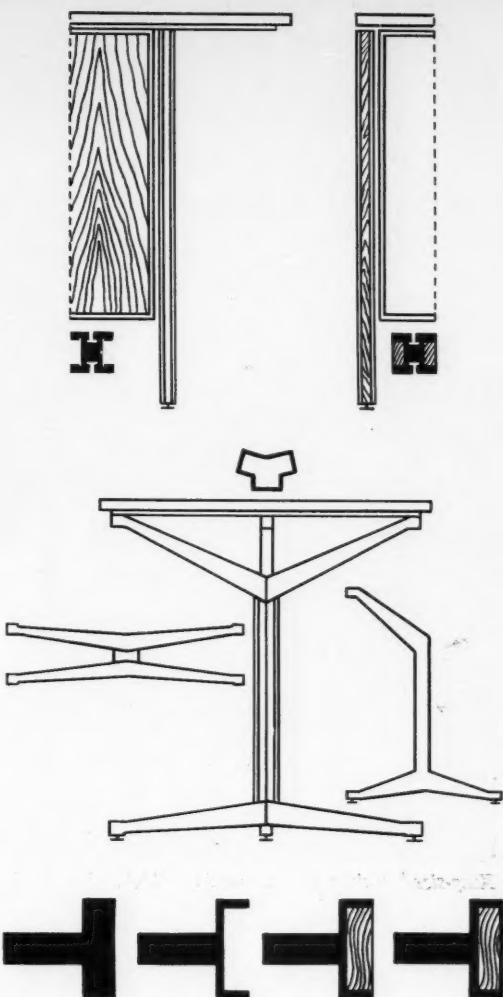
2. Designer Gerald Luss has manipulated all design factors to produce wide variety of comfortable chairs.

chairs, and a smaller, lower one for the side chairs. In the lounge version, there is one of woven reed stretched on a wooden frame; all the other shells consist of molded plywood padded with foam rubber. There are armed and armless versions in both lounge and side shells. Another variation occurs in the upholstery. In one version the padding of the back swells out in a bit of graceful sculptural contouring that supports nicely at the small of the back.

Variations in the legs are more striking. Every leg variation occurs in a higher side chair version and a lower lounge chair version.

Interchangeable components

The possibilities for interchangeable components in office case goods are even more dramatic. In fig. 3 the component part concept is taken about as far as it can go. A set of steel pedestals and steel structural frames is the basis of the system. All case facades—including the elevation of the legs and even the hardware—are



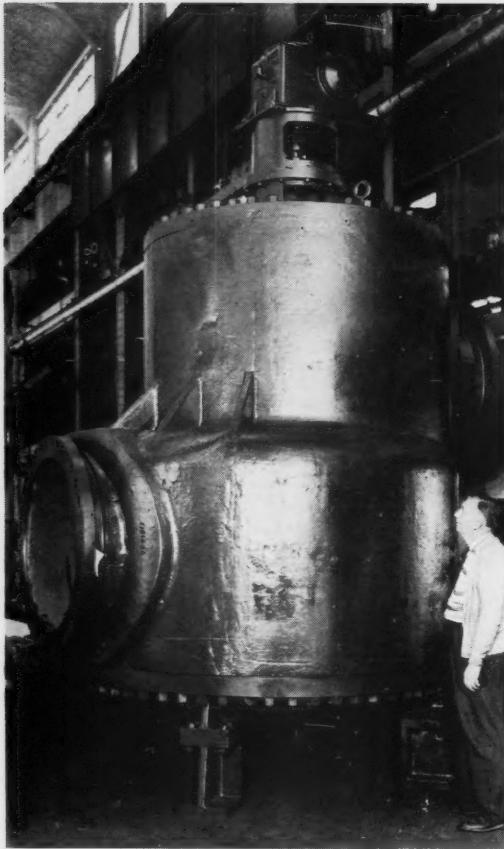
3. Interchangeable parts in office case goods make for dramatic arrangements.

made with a slightly recessed surface so detailed that an additional surface can be easily clipped on.

Proportions and finish are good even in the naked steel version, but middle echelon employees' desks have brilliant-hued plastic-finish surfaces added. For the senior executive, there is a choice of wood. Plastic surfaces come flush; wood surfaces project beyond the frame, adding another rich possibility.

As used today by architects and industrial designers, the module is a relatively new phenomenon. It rises out of the times and therefore takes its place as a discipline peculiar to the present but no more confining than the disciplines of the past.

Although a basically rigid system, it does not impose rigidity on either the architect or interior designer. Within the modular framework there is great latitude for self-expression and creative eloquence. It limits neither the individual concept of line against line nor the individual designer's approach to balance and proportion. *

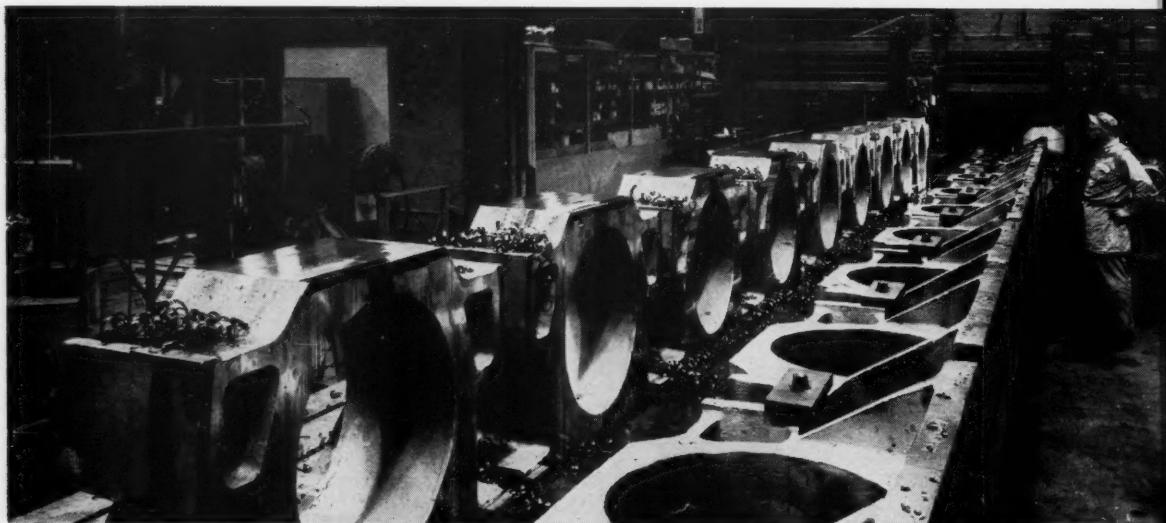


King-sized strainer stands over 16 ft. high. With another of the same size it will filter a flow of 150,000 gpm.

Designnews in Pictures



Russian-built thermo-electric generator will power electricity for a tiny radio.



It's cheaper by the dozen when you have a special holder for milling these 18 hinge-pin pillow blocks simultaneously. The holder, developed by Boeing Airplane Co., permits the use of carbide throw-away cutting tips which in turn allows programming on a Gray planer for multiple operation.



Rotors weighing 49 tons are part of the first steam turbo-generator made in Canada. John Inglis Co. Ltd. manufactured the \$2,000,000 generator for Ontario Hydro's Thunder Bay station at Fort William.



A revolutionary new porous plastic produced from linear polyethylene has applications in air and liquid filtration, electrolytic diaphragms and as a semi-permeable membrane in the separation of corrosive fluids.



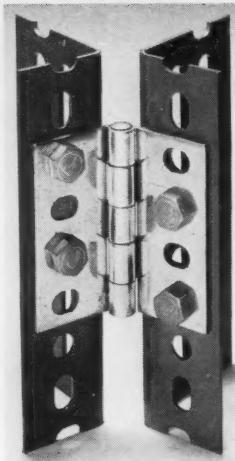
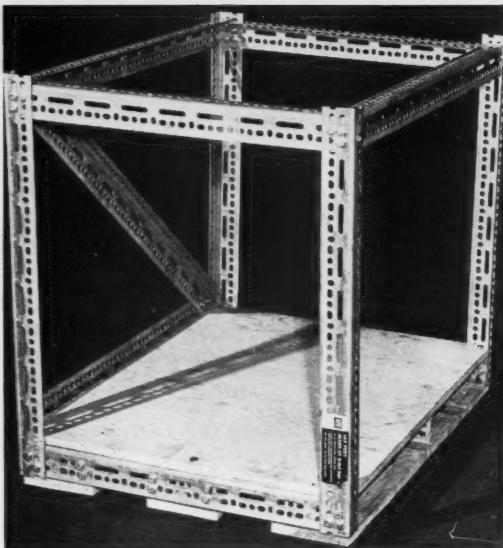
New type of telephone designed by Bell Telephone Laboratories is being product tested in Richmond, Virginia. The space-saver dial has a finger wheel smaller than current phones, though the holes are the same size.



Believed to be the biggest in the world and heavier than three full-grown elephants, this ten-ton crane hook will provide soft-as-a-feather handling for rotors and stators for steam turbine generators.



Reinforcement rings produce a pattern of light and shade in this 52½ ft stainless steel vessel being sandblasted in preparation for storage of liquid oxygen at a missile defense base.



Three industrial applications showing the varied uses of slotted angle.

Slotted angle—versatile design material

In hundreds of industries throughout the world slotted angles are the simple, single-source solution to problems of storage, materials handling, production and the construction of special equipment. Colin S. Morgan, AMI Mech E, AMI Prod E, of Dexion Limited, tells how it is done.

Though relatively recent in origin, slotted angles have made great inroads among the basic structural materials—timber, angle-iron and tubular steel—which serve the design, manufacturing, warehousing and materials-handling areas of industry.

Slotted angle is a post-war development on the relatively simple principle of the "Meccano" or "Erector" construction unit long known to small boys and their fathers. In its now familiar form, slotted angle was first patented and manufactured in the United Kingdom by Dexion Limited, but is now made and marketed by many firms all around the world.

In addition to the slotted angles themselves, most manufacturers market a range of compatible casters, hinges, reinforcing gusset-plates, shelf-panels, conveyor rollers and glidewheels.

Repeating pattern simplifies design

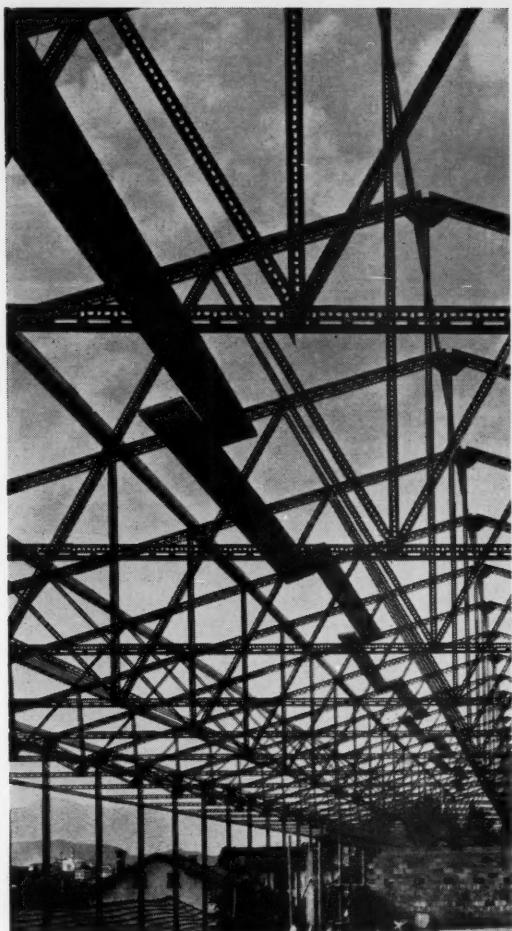
Thanks to the repeating pattern of slots and holes on both flanges, the material allows full scope for the inventive capacity of the engineer. Its assembly is simple, requiring no special skill in most widely used applica-

cations. Many firms, having learned the advantages of slotted angles, keep a supply always on hand, knowing that when the need for any structure arises, all they need do is to make a simple sketch, cut and bolt the angle best suited to the job, and put the new equipment to work.

The only tools required for most installations are a pair of spanners. Most slotted angles are readily cut to size with a hack-saw or, preferably, a guillotine-style cutter specially designed for the job.

Here are some points to be borne in mind when designing in slotted angle:

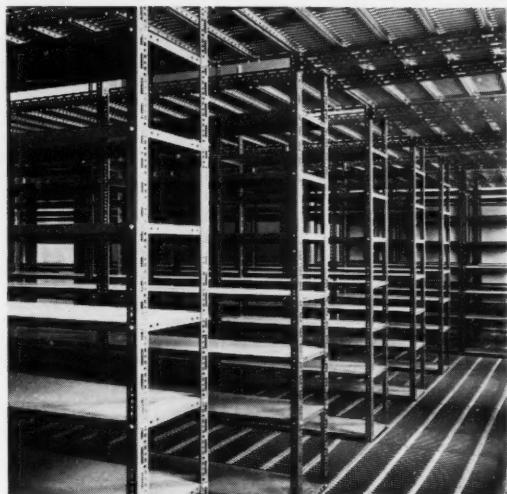
- Each individual angle is designed to perform adequately either as a beam or a strut—hence most angles have unequal flanges.
- The angles join together without having recourse to special joining pieces.
- A three-dimensional joint may be constructed simply by bolting three pieces together at right angles.
- All angles have a clearly defined module (or repeating pattern) of a suitable size, with round holes recurring at frequent intervals, for positive bearing.



Structural framing for a factory in Italy. Twenty-five spans of forty feet in width.



Cantilever construction was made easy in this bus shelter.



The problem of storage racks was simply solved in this installation. Note also the ceiling.

- The angle chosen should have a hole pattern which leaves as great an area of metal in uninterrupted bands, along the length of the angle, as possible—both along the edges and the “bend” or elbow.
- Most angles have a stamped cutting-mark at regular intervals, and are so designed as to leave no weak edges or asymmetric pattern when cut on the mark.
- The hole-pattern always permits 90° joining with at least two bolts, and affords maximum ease of bolting at any other angle.
- Angles should have a paint or galvanized finish which is applied *after* punching.

Dexion, as an example, is available in four sizes, ranging from heavy-duty "300" through standard "225", medium-duty "140" and midget "112". It may be obtained in both steel and aluminum alloy.

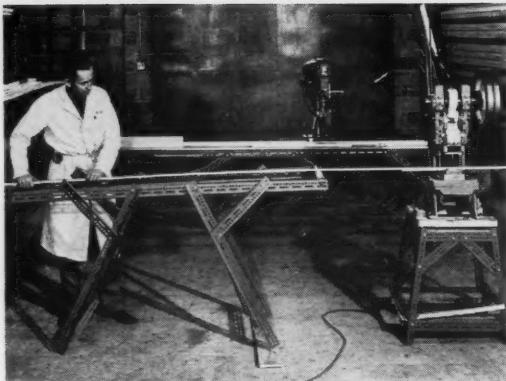
This family of slotted angles, in its variety of sizes, materials and finishes, permits a great degree of structural range and of economy, since each of the major angles is designed to bolt together with the others, permitting a combination of lighter and heavier members, as the purpose may dictate.

Economies up to 30%

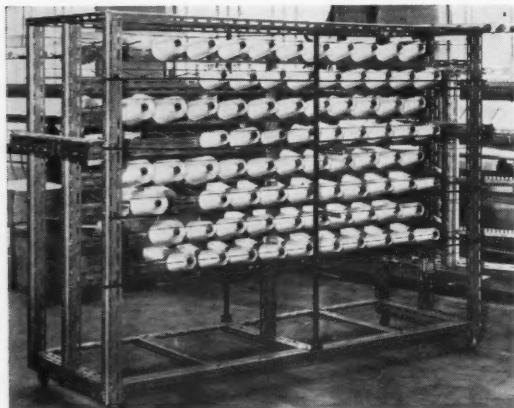
Most manufacturers of slotted angle offer to designers technical data sheets which define safe load ratings for various lengths and types of loading. One enterprising company has devised a method of prefabrication which makes possible economies up to 30% in construction time where repeating assemblies occur, such as the "ladder" frames in a racking installation or trusses in a roof-structure. In these cases, patented jig-studs are substituted for the normal nuts and bolts in the first frame, which becomes the "master" frame for a series of identical units.

When planning a slotted angle structure, the dimensions of the job to be built you should relate to the module of the angle. When lengths cut on the module are fitted together, maximum bolting opportunities result, making for good structural strength and rigidity.

Structures built up of a number of individual bays, as in long runs of racking, will "grow" in length, so allowance must be made when the space designated is



*Acme Metal Moulding Company
in Vancouver use slotted angle
in all their work areas.*



*Racks for handling yarns
in textile mills are readily
improvised and modified.*



*Repairs to aircraft can often
be improvised, even under the
most trying conditions.*

tight. Data sheets provide the necessary information in such cases.

Most slotted angles are made in standard 10-ft lengths. It is wise, when designing a structure, to keep this standard unit-length in mind. A 6 x 6 x 8 rack, for example, would leave a substantial amount of 4 ft and 2 ft offsets. Although these may be employed elsewhere, it is always advisable to use as few fresh lengths as possible. A simple cutting chart helps work out in advance the most economical way of obtaining desired lengths from the minimum number of standard lengths of angle.

Of great importance to any structure are its stability and rigidity. These are assured, in smaller structures such as benches, racks and trolleys, by the hole pattern of the angle itself, which enables two or more bolts at a connection to function as a gusset. On larger structures—mezzanine floors, towers, high-rise racks and grandstands—the rigidity of the connections should be supplemented with corner-to-corner diagonals in all planes. Structures such as mobile platforms and machine-guards which are subject to vibration should have the nuts locked in some way.

For simple jobs, a line sketch is all that is needed as a guide to construction. It is often useful to indicate with pencilled ticks which way the wide flange of the angle is to be located. For larger, more complicated work, detailed drawings are advisable, though it is seldom necessary to draw the entire structure, so long as all the needed information is provided. Your supplier has a fund of helpful information and construction "know-how" on which you may rely.

Many accessories are available

The range and utility of accessories available for use with the angle you choose will greatly increase the scope of design with this versatile product. Recent additions to the Dexion group include heavy-duty galvanized panels, available in lengths up to 8 ft. These shelves are self-supporting, may be bolted to the uprights at any level, and require no supporting cross-beams or additional bracing. Also newly available is an open steel plank, a grid-type flooring panel capable of taking loads up to 250 lb per sq ft, and highly useful in applications requiring stair-treads, gratings, and decking. New accessories to back up the basic angles are being introduced regularly. They are well worth keeping up with.

While slotted angle is widely used in racking and is commonly regarded as the industrial maintenance handyman's "do-it-yourself" standby, more and more engineers are making use of this revolutionary material, and are becoming ever more aware of the wider field in which it operates.

Slotted angle has been used regularly in designs for buildings up to 100 ft span, grandstands capable of seating thousands of people, masts and towers over 100 ft high, foot bridges, aircraft maintenance docks, gantries—a whole range of engineering structures, as well as an immense amount of storage and materials-handling equipment. There are also hundreds of applications in electronic and electrical consoles and cabinets, equipment mounts and design mock-ups.

Slotted angle can be stored more compactly than timber or angle iron. It is simple to use, requires a minimum of tools and equipment, is waste-free, pre-finished, recoverable and readily available anywhere in the world. It is a genuine engineering product; as such, it has a ready and varied application for everyone. ★



A study in attention. These are the rapt faces of those who attended the formative meeting of the Toronto chapter, Fluid Power Society.

Fluid Power Society forms in Canada

Toronto Chapter is first to be organised—Montreal next in line

A Canadian chapter of the Fluid Power Society, the first to be formed in this country, took shape at an enthusiastic meeting of over 50 manufacturers, distributors and users of hydraulic-pneumatic components in Toronto on January 25.

The group, many of whom became charter members, had responded to an invitation published in the January issue of Design Engineering. The editor of Design Engineering, A. Douglas Kaill, P.Eng., has taken the lead in forming this tenth chapter of the international society. In fact, he had called a meeting of engineers in Toronto as long ago as June 1959 to propose a Canadian Hydraulics and Pneumatics Association. This meeting took place 11 months before the Fluid Power Society was formed in Milwaukee, Wis., but the plan was deferred because the formative group of five drop-

ped their plans when they learned of the events shaping up in Milwaukee.

Four of those five members were present at the January meeting. They were Mr. Kaill, W. D. German, TEM Sales Co., Ltd., D. B. Guy, Bellows-Valvair Ltd., and C. F. Smith, Vickers-Sperry Ltd. The fifth, J. B. Morrison, was ill.

The original five, together with R. Allin, T. H. Beard, G. Goldstein and W. Rimmer, were elected as a steering committee to function until the first executive is formed. Future meetings will be held on the fourth Thursday of each month in the Maclean-Hunter Building, 481 University Avenue, Toronto.

Action on standards

Mr. Kaill, who was in the chair at the inaugural meeting, read a letter he had received from the Canadian Standards Association advising that standards relating to fluid power components and practice were being considered. It was also revealed that the CSA had formed a committee on which the fluid power industry was not represented. This disclosure resulted in some discussion at the meeting and it was decided that the steering committee should approach the CSA to ensure the new chapter being represented.

Earlier the meeting was addressed by F. L. Mackin, president of the Fluid Power Society. Mr. Mackin said that before the society was formed, several major associations both in the U. S. and Canada, had attempted to serve fluid power interests by forming auxiliary sections, but these were quite ineffective. He outlined the contribution that fluid power was making to many industries, including automotive, oil, construction, aircraft and mining. Mr. Mackin is from Flint, Michigan.

After presenting the Toronto chapter's charter, Mr. Mackin announced that Mr. Kaill had been elected a Director of the Society. The charter was received by the four original members present. ★



Four charter members of the Toronto chapter receive their charter from Frank L. Mackin (right), president of the Fluid Power Society. Left to right are W. D. German, D. B. Guy, C. F. Smith and A. D. Kaill.

Free engineering costs you money

Walter Irwin, President of Metal Atomizing Corporation, warns of this false economy

Buyers who habitually abuse the so-called *free engineering service* provided by suppliers of components may ultimately find they are unnecessarily inflating their costs to uneconomic levels.

Free engineering is help from an outside fabricator in the design or redesign of a part, say in conversion from a sand casting to a forging or die casting, in a change in specifications or material, or in the modification of machining or finishing operations.

Without such engineering help it would often be difficult for the buyer to exploit the full possibilities of processes or equipment with which he is unfamiliar. The supplier usually undertakes the engineering as part of his solicitation of an order and, where no order follows, there is no charge. But this doesn't mean the engineering is done for nothing. It can be and usually is quite expensive.

Take, for example, a component buyer who asks six suppliers for prices on a \$10,000 order. If each spends \$100 on engineering to develop his bid, the supplying industry may in total be engineering away the equivalent of the net profit to be earned on the order.

Unpaid research department

Or take the buyer who doesn't quite know what he wants and asks the supplier for a great deal of information which may or may not be relevant. Since this information enables the elimination of impractical procedures the supplier becomes, in effect, professional consultant or the unpaid research department of the buyer.

The sharpie among the free riders on the engineering train has the supplier prepare plans ostensibly as a prelude to an order but his real purpose is to obtain the design information and buy elsewhere.

Industry in general picks up an enormous tab for free engineering since it is a cost of sales solicitation included in general overhead. But ultimately the unwise user of free engineering suffers the most.

Unwise users of free engineering fall into three categories:

► **The free loader** who has reduced to a fine art the purloining of suppliers' blueprints and drawings,



which he passes to the no-overhead jobbing shop, operating without benefit of an engineering department. The free loader is not above substituting his own signa-

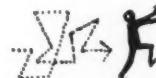
Here's how you pay for free engineering

- \$ Suppliers' selling overhead.
- \$ The cost of assembling and comparing plans and bids.
- \$ Errors in plans as a result of one drawing office not controlling them.
- \$ Loss of reputation with suppliers.

ture block on a supplier's plans and palming them off on other bidders as his own development.

Ultimately, of course, the trade comes to know the free loader as he is, and many suppliers ignore him. With his supply lines narrowed down, his operation is jeopardized almost as much as if he were a delinquent debtor.

► **Little Boy Lost** renders a reasonable facsimile of an airplane pilot who doesn't know where he's going but is nonetheless making great time. His disorganization is so complete as to make one think it is actually organized. He bugs everyone in the trade for information on prices and procedures, yet doesn't seem to know how to sift and apply them. He works considerably by intuition and impulse, and may even okay plans containing errors. The fault is usually inadequate checking, faulty liaison between designers, quality control and production and purchasing personnel, for which this dynamo of misdirected energy is responsible.



This buyer's organization is known for its personnel turnover and its air of bewilderment. It often acts in sheer panic, making last-minute purchases from trade factors which load their prices for the peace of mind which dealing with them provides.

► **The shotgun shopper** who spreads his requests for plans and prices over the entire landscape. An unusually high percentage of salesmen who call on him are asked for quotations and free engineering. This buyer does not realize that his purchasing and production people are largely frittering away their time obtaining prices and studying alternative plans which they cannot use. Additionally, the rounding up of quotations often delays order placing and deliveries vital to profitable production.

The shotgun shopper is also coppering his own bet by giving the supplying industry a completely erroneous idea of the dimensions of its market. His action is not unlike that of an investor who asks 10 financial houses for offerings of the same securities. Their shopping of the market is calculated to produce a minor upward trend in prices. This is the law of supply and demand, and no trade association or government can repeal it.

The real purpose of competitive quotations is not to auction an order off to the supplier bidding \$1 below anyone else but to obtain the lowest effective price. Obviously, an individual tender has to be studied in the light of the supplier's ability to maintain quality, effect

delivery, minimize the buyer's cost of expediting, etc. On the basis of price without qualifying considerations,



the buyer can easily award an order to a supplier ill-equipped to fill his commitments. Where there is a dispute as to quality of the parts, the legal position of the buyer who pressures a lame-duck supplier for deliveries is dubious.

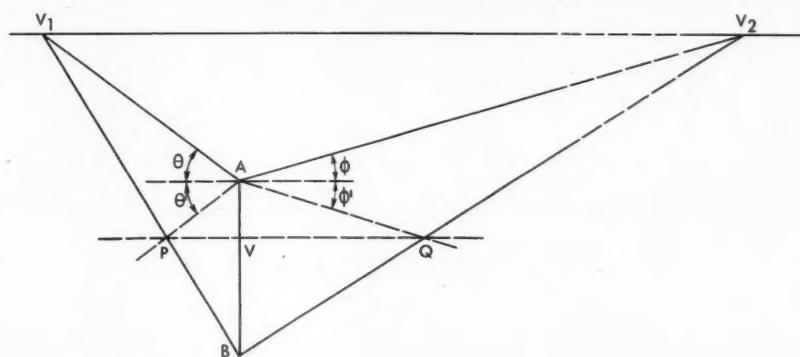
There are few items on which more than three prices should be sought if the buyer has kept proper records of capable suppliers using modern technology. He will know who has appropriate physical and financial resources. Profitable purchasing policy will also occasionally rotate orders because of the desirability of keeping the interest of worth-while suppliers alive for design and price information. Many suppliers who have gone to the expense of preparing plans and constantly lost out on orders on which they were competitive eventually abandon the shotgun shopper as hopeless.

Times will change

The time may yet come when suppliers will make charges for any engineering outside the range of rough sketches prepared by a salesman or in excess of that contained in information manuals, promotional folders, etc. The free loader will then be as dead as the dodo and the buyer who covers all the bases will come into his own. This day will be hastened by suppliers as a whole studying the buyers' viewpoint and some of the problems which plague him in this day of increased industrial complexity.

In the meantime here are a few rules the buyer should follow in the interests of amicable relations with suppliers:

- Hunt a supplier with a rifle, not a shotgun. No more than three quotes.
- If you need engineering help, engage a consultant. In no event ask more than three suppliers for plans.
- Keep a score card on suppliers' capacity.
- Allow adequate lead time. Don't plant a squash in the morning and expect to eat a vegetable dinner the same night.
- Don't peddle blueprints.
- Let the supplier who designs the part produce it.



Another angle to perspective drawing

Finding centre of vision for two point perspective is simplified

In an article which appeared in Design Engineering in February, 1960, some principles of perspective were explained to simplify the preparation of pictorial drawings. In particular it was explained that the centre of vision of a three-point perspective was at the orthocentre of the triangle formed by the three vanishing points. In the case of two-point perspective, the perpendiculars from any two points on a vertical through the Centre of Vision (C_v) to lines extending to the vanishing points intersected on the horizon line.

The latter construction can be adapted if the horizon line is above the two points A and B, as shown on the accompanying diagram, but such construction is confusing. Direct construction involves the use of long straightedges or lengths of string across a series of tables or on the floor.

● A relatively simple alternative construction is as follows:

- Let A and B be the two points in consideration.
- Let V₁ and V₂ be the vanishing points on the horizon line, with V₂ normally inaccessible.
- Let AV₁ make angle θ with the horizon.
- Invert angle θ, inserting BV₁ at P.
- Draw horizontal through P, parallel to the horizon line or perpendicular to AB, and intersecting BV₂ at Q.
- Invert angle formed by AQ with horizontal, giving AV₂, the required line.

It will be realized that it is not necessary for the actual horizon line to be accessible. It should also be particularly noted that AP and AQ are not necessarily the extensions of AV₁ and AV₂.

Various forms of the construction can be used. For example, if only the horizon line and direction BV₂ are known, any point V₁ may be taken. Alternatively, the construction may be applied if BV₁ and BV₂, and either AV₁ and AV₂ are known. *



Transformers in review, from left to right: World War II transformer; miniaturized version of same; and newest, smallest version. Another experimental miniaturized unit is being measured.

Bell Laboratories develops miniature transformers

Improved materials and design techniques have made possible repeated reductions in size for defense work

Both physically and electrically, transformers appear to be among the simplest devices used by electronic engineers. Yet, in many cases, the transformer is the basic component that establishes the electrical characteristics, controls the power requirements, and links together the important circuits of an entire system.

In many military systems, particularly those designed for airborne applications, power transformers

account for a significant portion of both the size and weight of the necessary equipment. Because of this close relationship of transformer size and weight to the over-all size and weight of airborne electronic equipment, there is considerable current interest in miniaturizing these important components.

Miniaturization implies a lot more than merely shrinking in size. With most electronic components, and especially with transformers, heat dissipation is an important consideration. When the size of a transformer is radically reduced, without changing its volt-ampere or power rating, the decreased area available for heat transfer results in an increase in internal temperature. This, in turn, can seriously affect its operating characteristics.

Concurrent with reduction in size and weight is another requirement: operation at extremely high ambient temperatures. For example, the transformers used

in jet aircraft must sometimes operate in environments as hot as 200 C. This means that the transformer must be designed to minimize temperature rise within the component and to withstand an adverse environment. Taken together, the size and temperature considerations generally require the development of new designs and manufacturing methods. To cope with a specific application, designers treat each miniaturization effort as an individual development problem, to take advantage of new materials that can operate reliably at the given temperatures.

As part of a program to uncover some of the important problems involved in miniaturizing transformers for use in high-temperature environments, the U. S. Air Force requested Bell Laboratories to undertake the development of miniature power transformers with certain electrical characteristics. Specifically, the Laboratories was asked to develop experimental, miniature power transformers capable of satisfactory operation over a range of ambient temperatures from -55 C to 200 C. The units were to be no larger or heavier than units designed under an earlier contract for -55 C to 85 C ambient temperatures. These earlier units were already extremely miniaturized.

Electrically, the prototype transformers were required to have substantially the same characteristics as their larger counterparts, over the new temperature ranges. To establish a suitable criterion for the results of the work, the Air Force chose for redesign six typical transformers from a specific airborne radar system used in World War II.

During the latter part of World War II and the years immediately following, the basic materials used in the construction of transformers were improved to such an extent that considerable progress was made in miniaturization. In a typical instance, a transformer of World War II vintage, having a volume of 74.2 cubic inches and weighing 7 pounds, was redesigned to a unit with a volume of 21.6 cubic inches and a weight of 1.4 pounds.

More recently, through improved design techniques and materials developments, the same transformer was further reduced in an experimental redesign to a volume of only 11.2 cubic inches and a weight of only 1.1 pounds. This series of miniaturizations is illustrated by the three units shown on the table in the

MINIATURE POWER TRANSFORMERS WEIGHT AND VOLUME CHARACTERISTICS

Type	World War II		Redesigned for—		Redesigned for—	
	Wgt. in pounds	Vol. in inches ³	Wgt. in pounds	Vol. in inches ³	Wgt. in pounds	Vol. in inches ³
I	0.44	8.3	0.2	4.1	0.2	2.7
II	1.0	18.9	0.3	6.0	0.29	3.3
III	1.0	20.0	0.32	6.0	0.29	3.3
IV	5.1	71.5	2.2	22.3	1.6	16.7
V	7.0	74.2	1.4	21.6	1.1	11.2
VI	1.5	17.9	0.9	6.0	0.24	4.3

accompanying photograph. All of these units are 400-cycle, plate transformers with the same volt-ampere rating. They are made of different materials, however.

The larger unit, on the left, is constructed with enameled wire, cloth, paper and insulating varnish. The middle transformer is made of ceramic-insulated wire, mica and Fiberglas insulations, and silicone-resin coating. The newest and smallest of these transformers uses nickel-plated wire insulated with a combination of ceramic and the plastic Teflon, mica and Fiberglas insulations and an impregnating and coating compound made of silicone rubber. In addition to being smaller and lighter than earlier designs, this newest transformer can operate within its rated range in the desired ambient temperature range of from -55 C to 200 C.

Evaluation tests were recently completed on miniaturized transformers of the rectifier, plate-supply type with these electrical characteristics: 1600 volts, 700 volt-amperes, 400 cycles. They were operated in an ambient temperature of 200 C at an altitude of 70,000 feet. The test units were operated under rated load conditions for 1000 hours, and then had the line voltage raised to 125 per cent for 24 hours. They suffered no adverse effects. These miniaturized models were also subjected to extreme water immersion and high-humidity exposures following the 1000-hour life tests. Again, there was no degradation of dielectric strength characteristics.

These remarkable reductions in the size and weight of power transformers have been made possible principally by the advent of new materials. From these new materials have come miniature transformers that perform well under present operational environments.

A famed designer says . . .

It is unmistakably clear that industrial design is not something that is superimposed upon a client and his products. Rather, it is a co-operative undertaking in which a group of partners work toward a common goal, each stimulating and supplementing the other. Of the partners, the engineer is the one with whom the industrial designer usually is most deeply involved. In our office we call the client's engineer the industrial designer's best friend and severest critic.

The designer does the dreaming — and it's rather practical dreaming — and the engineer makes the dreams come true. He brings to bear on them a particular skill the designer doesn't have. The final effort is a collaborative effort.

Henry Dreyfuss in "Designing for People"

Design Engineering opinion poll

Should engineers be more active in public life?



**Maurice Bourget,
P.Eng., M.P.
House of Commons,
Ottawa**

Engineers can be of great help to their fellow citizens by taking a more active part in politics, but we must not conclude that they are wholly disinterested. The great majority (90% or more) are employed by government at the federal, provincial or municipal level or work for private companies that do. It would be difficult for these men to seek public office.

The remaining engineers cannot go into public life either without risking loss of income. The remuneration paid to men in public office is not such as to attract professional men to take it up full time.

To those readers who study this panel carefully month by month: this time the response was enthusiastic. Engineers may not like to express opinions on allegedly controversial issues like discussion at association meetings, but they rushed joyously into print on the subject of engineers in public life.

politically minded. Although this may be of an advantage in that his decisions are not likely to be arrived at with the thought of re-election, it has the disadvantage that his approach to a problem may ignore the public per se. In some instances the apparent correct solution is not always the best one from the public viewpoint. There are a number of examples of so-called politicians being excellent public servants, and also examples of professional men being completely lost in public life.

The engineer is a generous contributor of his time and energy in the many associations that he is in contact with, either in the professional or business way, and with so-called public service groups. He has indicated that he is ready and willing to do his share towards the welfare of his profession and industry, and the public would benefit if some of his capacities were directed towards public life.



**P. D. Dalton, P.Eng.
President
Dalton Engineering &
Construction Co. Ltd.
Toronto**

When asked to consider the question "Do you think engineers should be more active in public life?" I infer that the reference is to an elected municipal, provincial or federal office. If that is the case there is no doubt in my mind that engineers, as a group, would have much to contribute, and should offer themselves as candidates for elective office.

The engineer's training, both academic and by experience, is directed towards examining the problem, arriving at a reasonable solution and putting it into operation. His natural inclination as an engineer is to determine what has to be done and to get on with the job. The experienced engineer has usually a more varied and wider business experience than other professional men. All of these qualities are valuable in dealing with business matters in the public interest.

On the other hand, the engineer is not usually



**Yvon-R. Tasse,
P.Eng., M.P.
House of Commons,
Ottawa**

Yes, positively engineers should be more active in public life. But we should agree on what we mean by public life. I guess it covers not only the House of Commons, the legislative assemblies and municipal councils, but also school boards, chambers of commerce and even social clubs.

One difficulty faced by engineers in politics is that they usually deal with abstract matters in the drafting of laws, while their training is in more material things. Sometimes some of the effects of these laws are difficult

to measure in advance, which again is not in keeping with engineering practice.

Not all engineers could adapt themselves to public life, but I don't think there can be any doubt of their usefulness in this sphere. A frequent criticism of politicians is that they do too much talking and not enough action. On the other hand it is often said of engineers that they don't do enough talking about their actions. If more engineers go into politics, a better balance might be struck between talk and action.

Since entering public life I have become impatient with those who criticize the politicians but refuse to have anything to do with politics. You get a lot more done if you're in front than if you're behind. It may be a tough job, but I have not seen many engineers shying away from a tough job.

If the engineer sets his heart on doing a job for his country, his province or his community, he can make a notable contribution.

earth", giving a stabilizing influence to organizations of which he may be a part. Usually the engineer's work places him in a position of authority over groups of workers or office staffs. This type of experience is not readily available to most other professions. Any person with an ability to direct people can fill a definite need on governing bodies of civic, church, or youth organizations.

From the standpoint of furthering the profession—and therefore the individual who is a member of the profession, it is important that engineers assume their share of public service. The more the public learns of the engineering profession and of good works done by members of this profession, the more favorably the engineer is seen in the public eye. The more he is willing to assume positions of public responsibility, the more he increases prestige for this profession and for anyone who proves himself an active part of it.



**W. R. Coulter, P.Eng.
President
Coulter Copper & Brass
Co. Ltd.
Toronto**

Lawyers and some other professional men are able to carry on with their professional activities, at the same time as serving in public office. Unfortunately with engineers this is seldom possible, and is possibly a factor in the relatively small number of engineers in public life.

Our public affairs would be handled more effectively, and more efficiently, if engineers, with the engineering approach to problems, were more active in our public affairs.

Name withheld

Some other opinions

I agree that more engineers should go into public life, but if I expressed such an opinion publicly I would immediately be inundated with requests for my services. I am not prepared to enter any phase of public life for two reasons. I have too poor a memory and not enough time to attend to my own business.

Name withheld

There is not a professional engineer in the Ontario Legislature. There are only three in the Federal Parliament. I suggest that if members of the profession will play a part in politics at all levels of government, the public will learn to understand and appreciate the value of the profession. The Engineering Institute of Canada branch and the Association of Professional Engineers of Ontario members in Peterborough have made a start. They formed a committee and by hard work elected a professional to the Public Utilities Commission.

**T. M. Medland, executive director, APEO,
to the annual meeting of the Association**



**D. A. Eisenhauer
Vice-president
Atlantic Bridge Co. Ltd.
Lunenburg, N.S.**

Engineers have few good reasons for not taking part in public life and there are many good reasons why they should. Every time an engineer refuses to offer for public service, or when asked, declines, he is not only limiting his own development but he is doing a disservice to his profession and to the country.

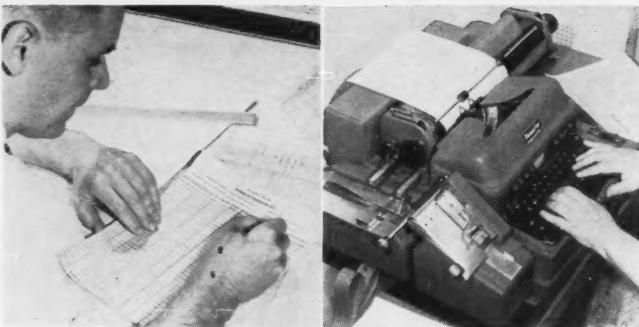
By virtue of his training the engineer's thought processes tend to be practical, logical and "down-to-

The world is engaged now in a titanic struggle between the democratic and communistic worlds. It is evident that whenever democracy fails, a dictatorship takes its place, usually in the form of communism, with its consequent loss of individual freedom. That is why I would urge you engineers to take an interest in public affairs.

In the House of Commons there are only three engineers, yet the House of Commons governs 18 million Canadians and is responsible for allocating the spending of six billion dollars a year. Will you make your contribution to make democracy work? For the democratic system is the best system yet devised to govern a country and at the same time preserving the individual freedom of the citizen. Provided we have sound government, the future of Canada is unlimited.

**The Hon. D. J. Walker, Minister of Public Works,
to the Engineering Institute of Canada**

NEXT: What engineering project would you most like to work on?



Left: Turret and table motions for each hole on the drawing are computed on programming data sheet in drilling sequence.

Right: Control tapes are produced by typing out programming data sheets on Flexowriter. New copy in carriage is checked against the original to make sure the tape is punched correctly.

**Company devises
tape control
system,
eliminates tooling,
saves time
and money**

High cost of short runs cut by numerical control

QUESTION: How can we cut high tooling costs on short drill runs?

ANSWER: By eliminating tooling altogether and using instead an automated system of production employing numerical control. Reproducibility is nearly perfect.

The question was asked by a company which supplies basic materials such as vulcanized fibre and laminated plastics. The answer came from the same company after it had bought a new turret drill equipped with a numerical tape control system, for which it designed and fabricated a special work table.

A large part of this company's business is in supplying precision fabricated parts. Sometimes quantities are limited because of the specialized nature of the equipment the parts are designed for. Sometimes a short run can mean from one to 300 parts.

For such short runs, tooling up on conventional equipment was costly both in time and money.

The company therefore acquired a numerically controlled drill press whose largest single benefit is its flexibility in handling short runs. The machine is equipped with a General Electric numerical tape control system which positions the work table and operates the turret according to individually programmed requirements. The control system responds to instructions punched in fibre tape.

Double program is possible

To get even more flexibility, the company's engineers designed a special work table to replace the standard

table. The new table is laid out with 322 positioning holes drilled on 1½-in. centres progressing from the common zero point. This gives an almost infinite variety of locations for positioning pins and allows the table to accommodate thousands of jobs without the use of fixtures.

The machine's working area is 15 x 26 in. As the table is larger, the entire working area can be used productively. Air clamps are positioned outside the working area if necessary.

It is possible also to double program the machine for two pieces of work, whenever both can be fitted in the work area. This permits the machine operator to load one work station while another is in automatic operation. Both work stations are served by the same tape loop.

The company's major markets are in the electrical, electronic and military field. A high standard of quality is essential, and the quality must be consistent.

Numerical control provides nearly exact reproducibility time after time, without a chance of human error. If the first piece is right, all are right thereafter.

A typical job

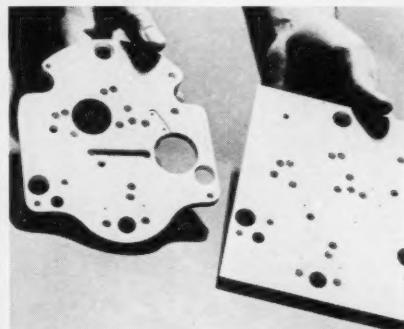
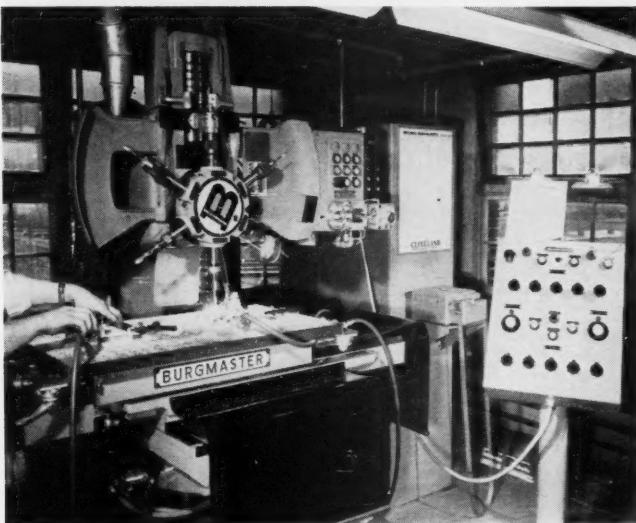
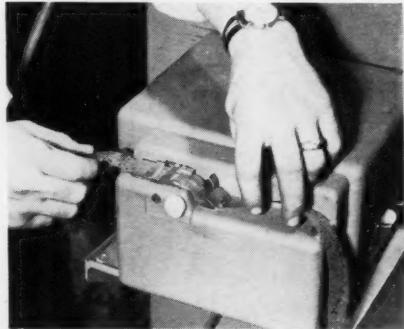
Taking the human element out of machining means significant savings for the company. The machine operator is not responsible for selecting the proper table feeds and spindle speeds. These are selected by a process engineer. Because optimum rates are pre-selected for each run, tool life is considerably extended.

A typical job was an aircraft computer part. This silicone-glass laminate bulkhead had 36 holes drilled



Left: Tool and positioning diagram tells the machine operator how work is positioned, what drills to use and what feeds and drill speeds are needed.

Below: Tape is inserted in the tape reader. It is spliced in an endless loop to repeat automatically.



Left: A special table containing 322 holes was designed. Here the system is double programmed to increase production.

Above: After the first piece is checked, the system operates with near-perfect reproducibility. Here is a typical silicone glass laminate part drilled by numerical control.

from each side. Formerly it required a drill jig costing \$160 which took a week to design and build. Ten different drills were required and it was not uncommon to find a hole missing in a completed part. Also, inaccurate positioning of the drill jig sometimes allowed smaller drills to veer off centre and ruin the work.

This operation is now done on the turret drill by numerical control. No drill jigs are needed and rejects are greatly reduced.

A considerable part of the company's business is custom fabrication to customer requirements. Design changes are thus continual. By eliminating the delays and heavy expense of fixtures, the company makes these design changes simply by a slight change in programming. For instance, a hole can be eliminated by running the old tape through a punch which cuts a new tape. The unwanted instructions are bypassed on the new tape.

The first step in programming a part is performed by a process engineer. He prepares a tool and positioning diagram sheet, noting the correct drill sizes, speeds

and feeds, and locates the work positioning holes.

Next a draftsman completes a programming data sheet. Using a fixed reference or zero point, he computes table and turret motions and lists them in the sequence they follow. This data is then transferred to the control tape with a Flexowriter, a tape-punching typewriter which also reproduces the programming data sheet for checking purposes.

Program sheet and tape then go to the machine operator, who selects the correct drills for each spindle, sets speeds and feeds, and inserts the positioning pins as indicated on the positioning diagram. He inserts the tape in a tape recorder and the machine is ready to operate.

At the push of a button, the tape starts through the reader, the work table positions itself in relation to the zero point, the turret spins to the proper drill, and drilling begins. When one hole is completed, the table re-positions itself at the next location. The process is repeated until all drilling operations are completed. ★

A rush design job for TCA's big jets

In-line amplifier engineered by Microdar of Canada will also be used by several U.S. airlines and by KLM

In less than 60 days, Microdar of Canada Ltd., Winnipeg, designed, developed and produced a transistorized amplifier to meet the needs of service crews working on the big DC-8 jet airliners put into service by Trans-Canada Airlines.

Service crews who refuel and maintain the big 129-passenger jets on stops across Canada and the Atlantic use portable headsets and microphones to keep in touch with each other. The DC-8s are equipped with plug-in points inside and outside for maintenance work.

When TCA put the big aircraft into service, Safety Supply Ltd., Toronto, supplier of the intercom set, needed a compact amplifier to go with the headsets. Existing in-line amplifiers were too big, so a rush call went out for a small amplifier.

58 in two months

Working to TCA specifications, Microdar produced an amplifier to fit into an aluminum diecast casing 5 in. long, 1 1/4 in. wide, and 1 in. thick, with a spring clip to attach to the front of a man's shirt. The aluminum casing sections are produced in a permanent mold.

The TCA rush order for 58 amplifiers was in the airline's hands within two months, and Microdar is continuing production under contract to the Toronto suppliers.

The small amplifier, Microdar model #101, was designed by Harold E. Rasmussen, formerly with Microdar in Winnipeg, and now on the TCA staff as an engineer in plant and ground equipment in Montreal.

The amplifier had to fit these conditions:

1. The carrier for the voice circuit is 28-volt dc power in the aircraft's electrical system.
2. A high voice level was needed.
3. The microphone was of the self-canceling type (Electrovoice 613 "7"), i.e. it reacts to sound waves from only one direction while surrounding noises coming from the sides are not picked up.
4. The amplifier cuts out almost completely any sound waves above 3,000 cycles, an important factor in high-noise areas such as around jet engines. Its optimum performance is in the voice range of 500 to 3,000 cycles.

U. S. airlines too

5. The earphones are padded with plastic-enclosed glycerine cushions that mold to the shape of the head.
6. A toggle switch is fitted to the amplifier so that on the off position the phones pick up any sound on the circuit. The microphone is live only in the on position.



Maintenance mechanic plugs in headset as he makes ready to check aircraft during stopover.

Similar intercom units are used with other large jet aircraft such as the Boeing 707 in the United States. Microdar's amplifiers, to be marketed by Safety Supply Ltd. as part of that firm's communications sets, will shortly be in use in the U. S. by various airlines, and overseas on routes of KLM Royal Dutch Airlines.

The Royal Canadian Navy is also using the intercom sets for gun crews on the aircraft carrier Bonaventure.

Wins merit award

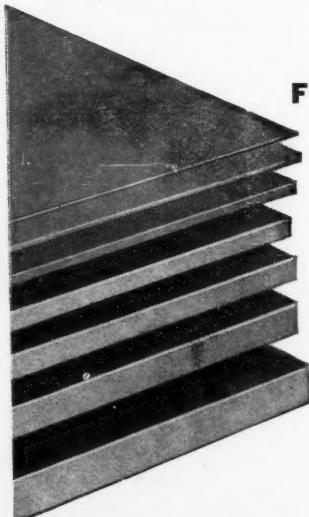
Microdar was one of five Manitoba firms to get a merit award certificate for its amplifier design from the Manitoba Department of Industry and Commerce last year. The amplifier was one of 69 products in a "What's New in Manitoba" display shown at the Red River Exhibition in Winnipeg and at the Manitoba Provincial Exhibition in Brandon. *



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Brazing furnace saves 80% heating costs

Designers use unique silica glass refractory for insulation

By using a unique cellular silica material to insulate their new atmospheric brazing furnace, a group of design engineers were able to save an amazing 80% of the estimated heating costs.

And, since they were able to eliminate four-fifths of the usual firing equipment, production costs were cut by \$80,000.

The furnace was designed for a large aircraft subcontractor to be used in the manufacture of honeycomb aircraft and missile parts. Honeycomb sections up to 12 feet wide by 20 feet long by 4 feet in height can be handled in the furnace.

Key to the furnace's performance is a new, light-weight refractory, Foamsil, a product of the Pittsburgh Corning Corporation. The material is 99% pure fused silica glass foamed in a special, very high temperature furnace to create millions of tiny sealed cells. The material can cycle from -450F to +2,000F without thermal shocking. It weighs only 13 pounds per cubic foot, yet has a compressive strength of 200 pounds per square inch.

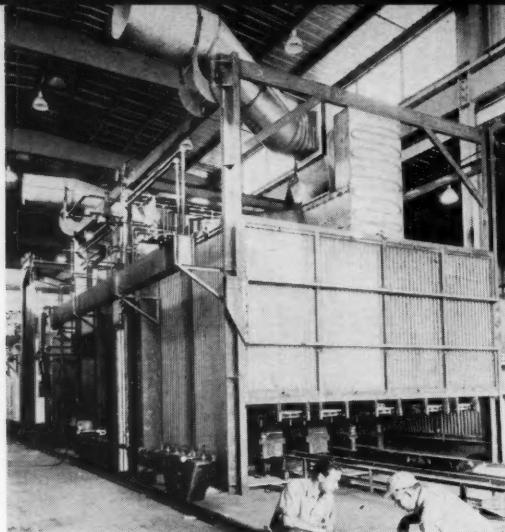
However, the key factor is the material's low specific heat—only .277 at 1,200 F—combined with light weight.

The tremendous growth of the aircraft and electronics industries has brought with it complex problems in the design and manufacture of components to make them smaller and more heat resistant. This, in turn, has called for new concepts in furnace design—faster handling methods, automatic controls and consistently even heats. The art of brazing, itself, has become more complex by the day because the demand for these components has brought special stainless steels and rare alloys out of the research stage and into actual production.

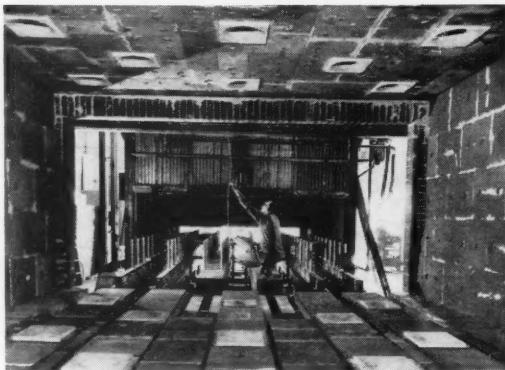
The introduction of these metals has necessitated new brazing techniques and new furnace designs.

The problem is to make dependable brazed joints in these alloys on a production basis and with a minimum of rejects. To do this, a brazing furnace must provide accurately controlled heating and cooling cycles; in many cases, allow components to be handled in the protective atmosphere of a retort; and must provide facilities for fast loading and unloading.

In designing the production brazing furnace, three honeycomb brazing problems had to be overcome—(1) the material had to be held very straight; (2) it must



General assembly, including cooling chamber and heating section.



Interior of heating chamber with heating forks installed.

be heated to the desired temperature very rapidly; and (3) the heat must be taken out of it quickly to enable the braze to set.

The first problem was overcome by the design of a portable furnace which would move over the part to be brazed as it rests on upright rods and then backs away from it after the brazing operation.

"Foamsil" took care of the other two problems because of its low residual heat capacity, light weight and low heat storage capacity.

The furnace is designed to operate at a temperature of approximately 2,000F. Over-all dimensions are 91 feet by 21 feet. Forty-six gas burners supply the needed heat.

A total of 3,000 board feet of "Foamsil" was installed in the furnace. A double row of 17 in. by 22 in. blocks were installed; one layer of two-inch thick and another of three-inch thick. Special "Foamsil" cement was used as the adhesive. A four-inch layer of another insulating material was used as back-up.

Total weight of the furnace is 75,000 pounds. The hearth alone weighs 25,000 pounds. Total cost was \$163,000. Of this figure, \$20,000 was for heating equipment, which represented a saving of \$80,000.

Apart from fuel and equipment savings, the large, but light, cellular silica blocks enabled speedier installation with accompanying savings in labor costs. ★

Durable new bearing a design triumph

Base life of 20,000 hours, lifetime recirculatory oiling system

The design advantages of both sleeve and ball bearings are combined in a remarkable new type of bearing with a base life of 20,000 hours. Other unique features include a lifetime recirculatory oiling system and a hydrodynamic oil film between the inner race and the bushing which supports the weight of the shaft.

This packaged, off-the-shelf bearing is interchangeable with ball bearings in bore and shaft requirements. The outside diameter is comparable in size and width to conventional ball bearing races, but the two shoulders which enclose parts of the lifetime recirculatory oil system are of smaller diameter.

Vibration-free and noise-free, the bearing is resistant to humid and gritty atmospheres and does not leak oil. Recommended operating temperatures range from -25 to 2,000 F.

The company which manufactures these bearings supplies charts showing their life expectancy at various loads and speeds for each size. With this data, designers may effect substantial savings by matching bearing sizes to their exact operating requirements.

The bearings may be used in virtually any applications which now employ ball bearings. They are recommended for applications where noise, vibration and conducted resonance are a problem, as in appliances, electric motors and ducted fans; in highly abrasive or humid atmosphere, as in grinders, washers and pumps; in applications which cannot tolerate oil contamination, as in textile machinery; and in locations inaccessible to service. Its principles have been tested on oiling, as in machine tools, automotive chassis and electrical systems.

Designed around a babbitt-lined bushing and a reservoir of self-wicking lubricant, the bearing is provided with a steel inner race comparable in function and tolerances to a ball bearing inner race. It is the first off-the-shelf bearing to support a shaft on a hydrodynamic oil film. By eliminating metal to metal contact, the oil film minimizes heat build-up and friction.

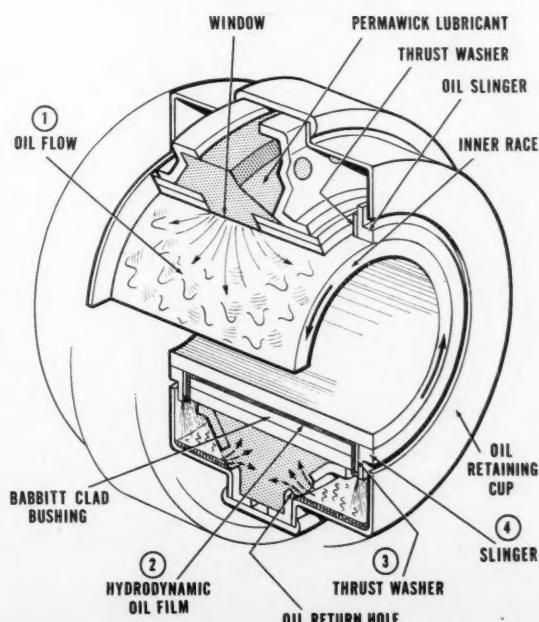
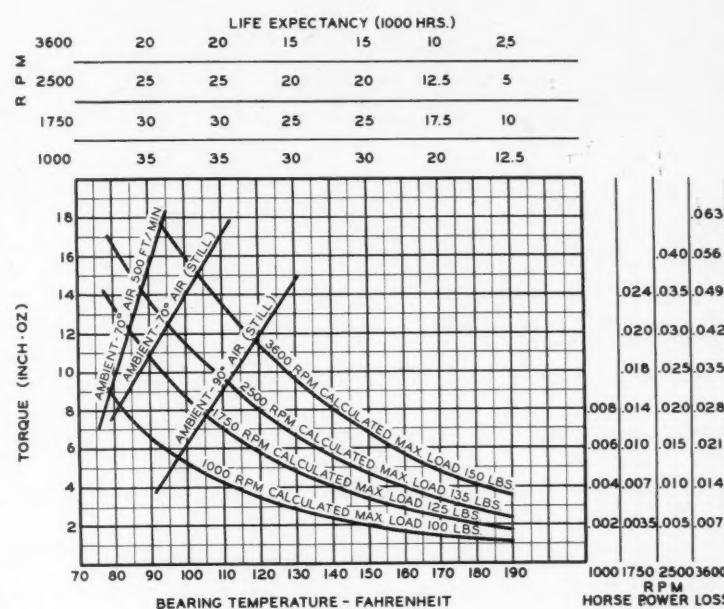
The new bearing line is scheduled for volume production this fall, but its principles have been tested on several million fhp motors in the past five years.

Several dozen motor manufacturers now use self-wicking lubricant and individually engineered bushings,

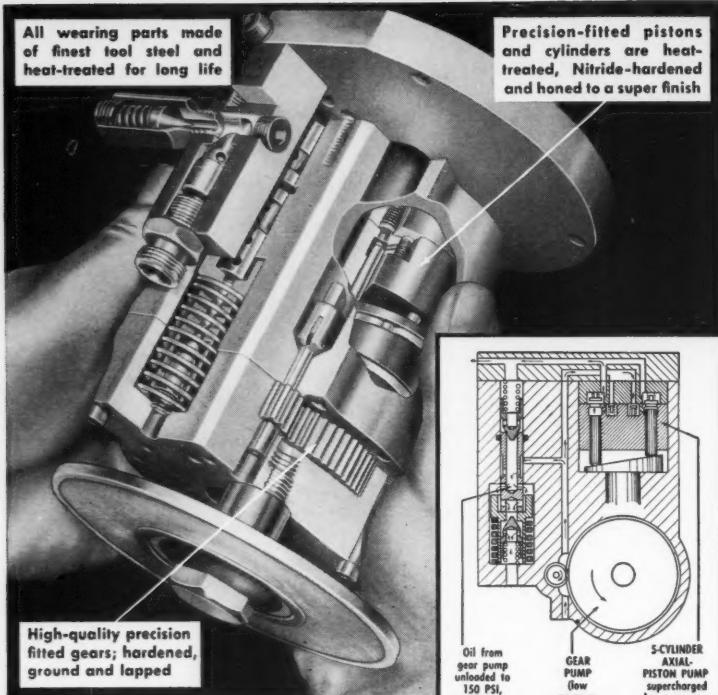
slingers, etc., to produce a bearing with a hydrodynamic oil film and lifetime lubrication. Oil is released to the shaft through a bearing window. Oil slingers on the inner race and an oil return passage at each end of the bearing complete the recirculatory system.

This system possesses the unique

property of permitting release and re-absorption of oil as required to maintain the hydrodynamic oil film, thus constituting, in effect, an internally regulated, self metering oil system. When oil is re-absorbed by the wick, impurities are filtered out by its fibres.



1. Oil is drawn from Permawick through window.
2. Rotation of inner race generates hydrodynamic oil film.
3. Oil forced to bearing ends lubricates thrust washer.
4. On leaving washer, oil is slung to oil retaining cup.



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Designers' book shelf

Solar Cell and Photocell Handbook, by John Sasuga. Publisher—International Rectifier Corporation, El Segundo, California. 100 pages. Price \$2.

Contains over 75 practical light-operated circuits, projects and demonstrations of both selenium photocells and silicon solar cells. Included are chapters on basic photovoltaic theory, nomenclature, radiation theory, power supplies, relays, infrared and ultraviolet photocell applications.

Up-to-date material is included on recently developed silicon solar cells, and their use on satellites and space vehicles. An excellent handbook for designers.

Circle 300 on Reader Service Card

Standard Costs for Manufacturing, by S. B. Heinrich. Publisher—McGraw-Hill Company, Toronto. 400 pages. Price \$9.75.

The need for versatility is most important to engineers. To rise to the top in industry one must be more than a specialist. A knowledge of standard costing procedures is one of those fringe areas that often pay dividends.

The author of this book explains standard costs from the ground up. How to set, how to apply and how to benefit from them are all included in the text.

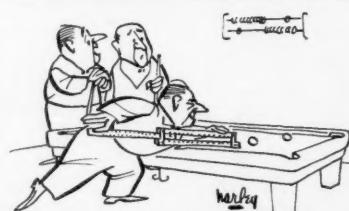
Circle 301 on Reader Service Card

Product Engineering Design Manual, by Douglas Greenwood. Publisher—McGraw-Hill Company, Toronto. 340 pages. Price \$11.50.

A useful guide to help designers get quicker, easier solutions to the engineering problems likely to arise in everyday assignments.

A full range of engineering topics is covered, from accessories to clutches, from electrical components to mechanical devices. It offers a ready-made file of methods, drawings, tables, formulas and charts.

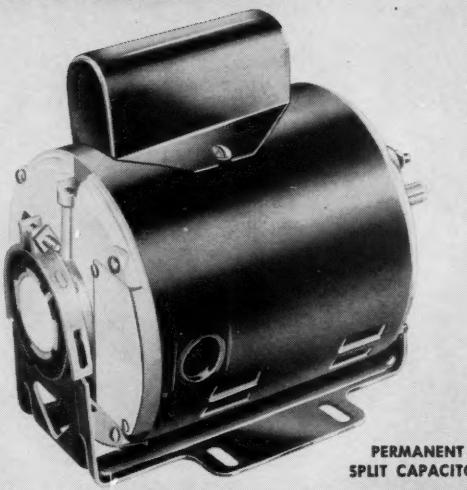
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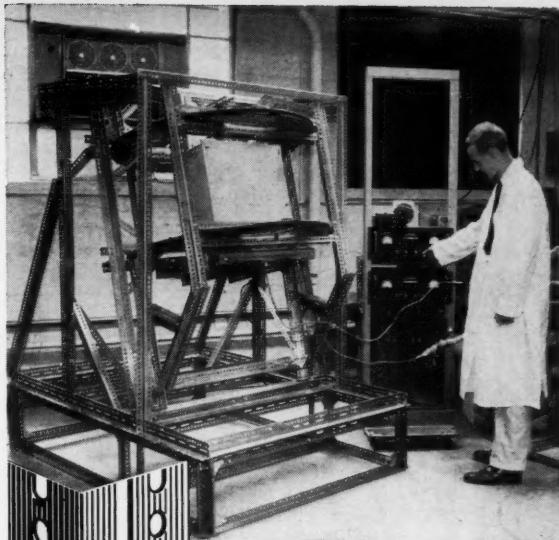
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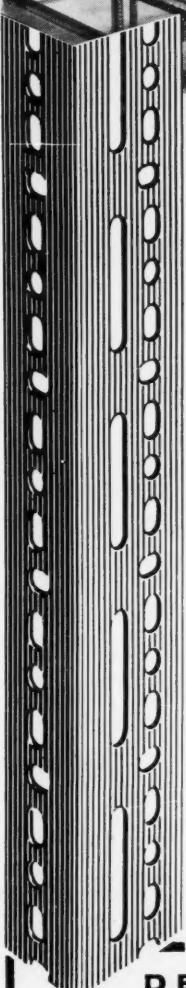
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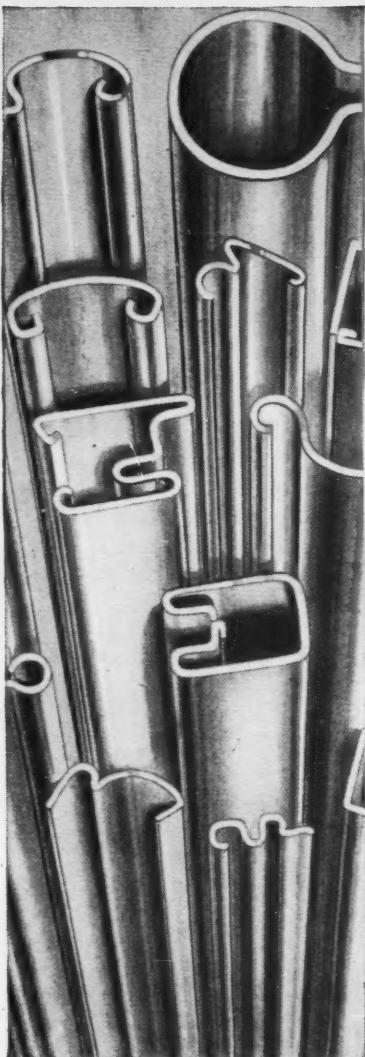
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Letters to the Editor

(continued from page 3)

That particular project, which I developed, built and partially tested at considerable expense to myself, has now been left at the "caveat" level to await extra funds and spare time. Although there is no indication that further tests will reveal the need for more modification or re-approach from a new angle, the mere fact of experimenting alone along unknown paths warrants extra caution.

Not much point

There is not much point in patenting an idea until it is proved to be an improvement over existing devices. An attractive theoretical idea might present insurmountable construction drawbacks.

Most companies that might be interested in such designs or attempts are subsidiaries of large foreign firms and require their employees to relinquish their rights to inventions. There is little hope of Canadian freelance inventors surviving beyond the point of sheer curiosity unless their inventions are very simple in principle and construction or unless they have considerable means.

A. L. Perrin

Agincourt, Ont.

More about downgraded draftsmen

Dear Sir:

I read the very ably written and thought provoking article in your February issue entitled "Are draftsmen downgraded in Canada?" This article should be read and studied by all draftsmen, engineers and management executives of our various industries and technical services. (It hit the nail on the head.)

Having been associated with engineering on various levels in this country and abroad as well as in Her Majesty's Forces (RCN), I congratulate the author on his knowledge and understanding of the complex problems which face the so-called "draftsman". The material presented is a real challenge to all associated with engineering. Studying the article in detail and in its entity, I have a feeling that we have to tear down a few fences and dispense with some prejudices.

What is a draftsman?

What is his professional status?

What has he contributed to engineering industry and the economy as a whole?

The "draftsman" of Canada does not have to consider himself inferior to his counterpart in any other technologically advanced country. Do most good draftsmen come from abroad? Have we forgotten our war efforts? Our post-war developments? Our rapid industrial growth? What did the draftsmen do then?

I agree with the author, the "draftsman" should be given more scope and responsibility in many areas. However this picture has many bright points.

As the draftsman is actually a person of many talents and varied background, the profession should be categorized far more than it is now with the opportunity to attain or "earn" certification similar to Higher National in Great Britain or TECH in Germany, Switzerland or France. At the higher levels, we could establish design draftsman, engineering designer, design specialist, design coordinators, stress analyst, specialist design standards, specialist design development. This will narrow the gap and give well deserved prestige to the senior draftsman of merit.

I hope the draftsmen of Canada will accept this challenge and prove your confidence in the "down graded profession" by becoming a more productive, more creative, and more enterprising member of our engineering and industrial development teams. This article may well spark new efforts to stem the ever increasing wave of unemployment by finding ways to do things better, quicker and more economical in Canada. I always said and still maintain; if you can't draw it, how can you make it?

I like your article, it has real "meat" in it and I hope it will lead to better things for Canadian draftsmen and Canadians.

O. W. Laderach, MASME
Peterborough, Ont.

(If we can refer you back to the original article in February, you will remember that our title was in the form of a question. If you will also turn to our editorial on the same subject in the February issue, you will see it is our opinion, if the draftsman is downgraded, that he probably has himself to blame. Opportunity for advancement is available, but the draftsman must be fully qualified.

We also refer you to the articles in the August, 1960, and January, 1961, issues on "engineering technicians." Recognition can be gained by draftsmen, through the technician program of the APEO. Many thanks for your kind comments.—Editor)



Save the round trip!

It's disquieting the way hundreds of tons of Canadian Magnesium are exported abroad only to return to Canada in the form of manufactured products.

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We don't want to keep magnesium products out of Canada. Neither do we ask you to buy Canadian Magnesium just to support a home industry. We suggest that you buy it for the same reason we can sell it in Europe, Asia, Africa and Australia: because it is good business to buy a structural metal unequalled in its 99.95% purity...in its remarkable lightness, strength, durability and versatility.

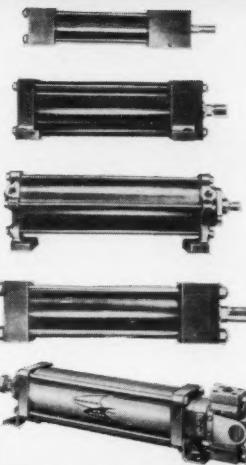
We'd be glad to show you how Domal Magnesium cuts cost, speeds production and extends service life in thousands of applications from jet planes to household products.

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320 BAY STREET, TORONTO, CANADA

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DESIGN ENGINEERING MARCH 1961

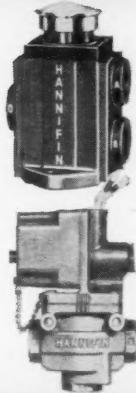
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POWER CYLINDERS



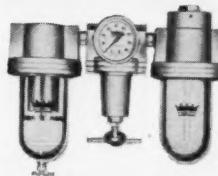
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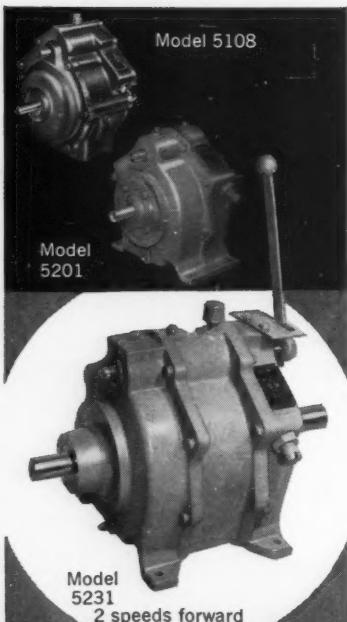
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*5 models 8 and 28 h.p.
with power packed
versatility*



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SPECIFICATIONS

Model No.	5231	5201	5108
Reduction Forward	1.97:1 3.34:1	3.16:1	3.75:1
Ratio Reverse	3.37:1	3.16:1	3.75:1
Power Up To	28 HP	28 HP	8 HP
Max. Input Torque in. lbs.	1000	1000	320
Max. Input Speed RPM	2400	2400	2400
Dimensions	Long 15 ¹¹ / ₁₆ " 14" 14 ¹ / ₄ "	Wide 11 ¹ / ₂ " 13 ¹ / ₂ " 14 ¹ / ₄ "	High 9 ¹ / ₁₆ " 10" 10 ¹ / ₂ "

SNOW-NABSTEDT
Industrial Division
Transmission Engineers
For Over Half a Century

For further information mark No. 154

Technical literature

Plastic packaging materials—Booklet describing the advantages of plastics in the packaging of commercial and industrial products, as jars, closures, coatings, laminations, flexible film, etc. Eastman Chemical Products Inc.

Circle 303 on Reader Service Card

Pump glands—Brochure describing a new gland designed to solve rotary sealing problems. Bestobell (Canada) Ltd.

Circle 304 on Reader Service Card

Abrasive products—42-page booklet entitled Abrasive Products for the Construction Trades, listing cutting blades, floor hardening materials and other products for the masonry and concrete trades.

Circle 305 on Reader Service Card

Nuts—a 16-page design engineer's condensation of a 144-page catalogue on hexagon nuts, locknuts and other types. National Machine Products Co.

Circle 306 on Reader Service Card

Glassed pipes and valves—Bulletin showing their purpose in installations that require resistance to corrosion or contamination. Pfaudler Permutit Inc.

Circle 307 on Reader Service Card

High-intensity infra-red heaters—Four-page bulletin on a line of heaters suitable for heating exposed or partly exposed areas; the heat rays pass through the air without heating it, but heat objects and people they strike. Canadian General Electric Co. Ltd.

Circle 308 on Reader Service Card

Cryogenic storage vessels—Brochure describing tanks for the storage of liquefied gases and showing their advantages over pressurized gas cylinders. Chicago Bridge & Iron Co.

Circle 309 on Reader Service Card

Radioisotope products—Catalogue listing products available from the commercial products division of Atomic Energy of Canada Ltd., including equipment accessory to the use of isotopes.

Circle 310 on Reader Service Card

Worm gear screw jacks—Bulletin giving engineering data, including ratio tables. Midland Foundry & Machine Co.

Circle 311 on Reader Service Card

Laminated plastic—Technical data sheet on a new flame-retardant industrial thermosetting laminated plastic with applications for both electronic and electrical uses. Synthane Corp.

Circle 312 on Reader Service Card

The 3M story—Booklet describing the wide range of products manufactured by Minnesota Mining & Manufacturing of Canada Ltd. (which, despite its name, mines nothing).

Circle 313 on Reader Service Card

Wool felts—Technical bulletin on Comparative Chemical and Physical Proper-

ties of Wool Felts, covering the most frequently used SAE and commercial standard grades with a brief account of the fabrication capabilities and typical uses for each felt. American Felt Co.

Circle 314 on Reader Service Card

Extruded acrylic sheets—Bulletin containing information on handling, machining, forming, cementing and annealing; also gives table of properties and light transmittance charts. Cadillac Plastic & Chemical Co.

Circle 315 on Reader Service Card

Engine tester—Pamphlet on a testing and checking device for vehicle equipment. Robert Bosch (Canada) Ltd.

Circle 316 on Reader Service Card

Ballistic flarer—Folder describing a cartridge-actuated tool that allows even heavy wall stainless steel tubing to be flared. Railway & Power Engineering Corp.

Circle 317 on Reader Service Card

Silicone coatings—Publication describing various applications of silicone release coatings and showing why silicones give outstanding release properties. Canadian General Electric Co. Ltd.

Circle 318 on Reader Service Card

Air control valves—Catalogue on two, three and four way five-port poppet type valves, together with in-line and sub-base mounted styles and other types. John Spottin Co. Ltd.

Circle 319 on Reader Service Card

Abrasive hard gear finishers—Bulletin showing how they are used for final surface conditioning of gear teeth after hardening and discussing uses, cutting fluids, new resins for hones and automatic loading and unloading. Colonial Tool Co. Ltd.

Circle 320 on Reader Service Card

Tool steel selection—Wall chart showing at a glance the chief characteristics of 23 tool steels so that engineers can specify without extensive metallurgical knowledge. Atlas Steels Ltd.

Circle 321 on Reader Service Card

Structural steel—Booklet on a new structural steel offering higher yield strength, better weldability and improved notch toughness and made to a new Canadian Standards Association specification, CSA G 40.8.

Circle 322 on Reader Service Card

Selling to the Canadian Government—Booklet of that title describing methods and procedures of government procurement and giving methods on tenders and contracts. Department of Trade and Commerce.

Circle 323 on Reader Service Card

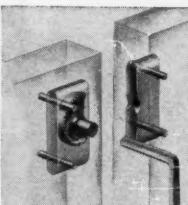
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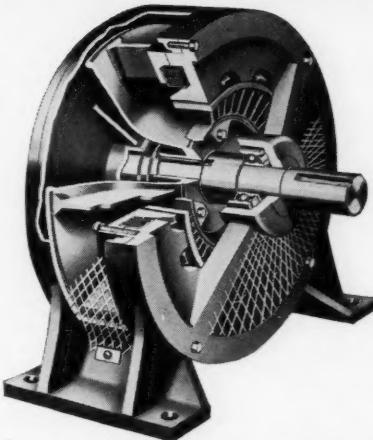
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Here's a brake that's really versatile. It can be used for numerous money-saving applications. For example—to provide controlled tension or constant linear speed when metal, fabric, plastic or paper is paid off a roll... to accurately control the lifting and lowering functions of cranes and hoists.

Other Practical Advantages Include—

- No mechanical contact to cause wear
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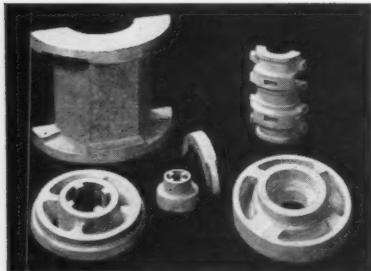
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prove...
BEARIUM METAL
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wears longer than
all other types of
bearing materials.

BEARIUM METAL's amazing superiority is due to the uniform dispersion of microscopic lead particles within the copper-tin grains rather than between the grain boundaries as found in ordinary bronzes. Result is that it will not seize or score the shaft nor will it melt out like babbitt—even in applications where a liquid other than oil must be used as the lubricant.

If you have a bearing application calling for dependable, trouble-free performance, by all means BEARIUM METAL is your best buy in bearing bronze. Try it on one of your toughest jobs. You'll be glad you did!



FEATURES: Non-Seizing and Non-Scoring • Long-Wearing • Self-Lubricating • Low Coefficient of Friction • High Compressive Strength • Resistant to Shock Loads • Sound, Uniform Structure.

AVAILABLE IN: cored and solid bars, centerless ground rods, machined parts, pattern castings.

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For further information mark No. 106

Briefs

They've automated public address announcements at airline terminals. The way it works is that basic messages are pre-recorded on magnetic tapes; from these segments, thousands of different announcements can be made — the clerk simply punches the appropriate numbers and goes on to other duties, leaving the system to do the rest. Best news is that this promises to solve the problem of unintelligible messages . . .

Miscellany: Civil engineers have found a way to create artificial spawning beds for salmon so they won't have to swim upstream to spawn . . . what is believed to be the oldest industrial coupling still in service has been found in Tyrone, Penn. — it was installed in 1922 . . . National Research Council has completed a \$170,000 vertical take-off airplane engine laboratory . . . A five-inch grease gun made in Britain is said to be the smallest in the world . . . France is one of the world's largest farm machinery markets, according to Massey-Ferguson Ltd., which recently opened a 360,000 sq ft plant just outside Paris . . . the Gray Iron Founders' Society has given ductile iron official recognition side by side with gray iron . . . Unusual use for tinned steel wire is reinforcing beehives . . . Westinghouse has produced an electronic tube so sensitive that it can "see" individual particles of light . . .

A U.S. company has developed a device to eliminate carbon gases from auto engines. It will cost about \$50, is easily installed and should last the life of the car. And if you seem to remember reading of a similar device before, you may be thinking of a Toronto mechanic's invention which got space in this column two months ago. At that time we reported that he had spent five years on it with as yet no financial reward. The inventor's lot, as we pointed out then, is not a happy one . . .

The Engineering Institute's annual survey of engineering registrations shows that enrolment for the current university year is 14,940, an increase of 465 from the preceding year. To these students (and to you) we pass the glad news that engineering management jobs are more plentiful than a year ago, according to a New York survey—23.3% of firms are looking for top engineering personnel, compared with 22.4% previously . . .

They said it couldn't be done, but . . . Two men in Guelph, Ont., neither of them engineers, have developed a pizza-vending machine after engineers repeatedly told them the idea was impractical; workers in a spaghetti house, they have patented their invention in

Washington and Ottawa . . . A British manufacturer has perfected a paint that kills flies and all flying and crawling insects; once they cross the surface they absorb the poison and die, but first they head for the open; the paint remains effective for two years . . . And another British manufacturer has developed a street light standard which bends in the middle for easier maintenance . . .

Auto news: A new stainless steel is being used for a muffler which Ford is putting in its 1961 Thunderbird; it will last at least three times as long as the standard muffler, it says here . . . Talking of mufflers, American Motors are using a new design on the 1961 Rambler which is guaranteed to last the life of the car "while in the hands of the original owner" . . . 500,000 motorists will be driving electric cars within six years, predicts an executive in the electrical supply industry; and a Canadian Westinghouse official estimates the industry would reap a billion dollars a year if every car in Canada were powered by electricity . . . Aluminum Co. of America says eight cars now offer aluminum power plants, and the American Zinc Institute says that while new materials such as aluminum and plastics are making progress, this progress is rarely at the expense of zinc . . .

Space notes: It may not have much historic significance by then, but May 4, 1964 is a possible date for the U.S. to send a space capsule hurtling toward Mars; a scientist says that's when earth and the planet would be in the best position to permit an electrically propelled capsule to reach orbit around Mars, which it would reach around November 3 and orbit on January 4 . . . The U.S. is ready to work on a flyable nuclear rocket engine which will probably double the specific impulse of engines for space flight and thereby increase the country's ability to place heavy satellites and larger payloads into orbit . . . A prototype of the first nuclear reactor for outer space has successfully



"Well, when the TV division cut down production we had this surplus . . ."

fully completed operational ground tests . . . A U.S. company has changed the name of its missile division to space division . . .

Short takes: Nuclear engineering has come of age at the University of Illinois, which has initiated an educational program leading to the doctorate of philosophy degree; this follows two years after the university started nuclear engineering for a master's degree . . . Solar heating can be done successfully, but won't become widespread for a long time, a New York technical conference learned recently . . . Canadian General Electric has developed an efficient heating method to keep large diameter surge and water storage tanks ice-free regardless of water level height — it's done by suspending the heating elements from the roof of the tank . . .

Tailpiece (with the same automation theme as the opening piece): The psychiatrist needed a cup of coffee in the worst way, so he said to the patient, "Look, I have to step out for a moment, but keep on talking; my tape recorder will take down everything." A few moments later who should step into the coffee shop but the patient. Brushing aside the psychiatrist's expostulations, he said "Don't worry, I have a tape recorder, too, and now my recorder is talking to your recorder." ★

ALPHA HELPS THE HAND THAT SHAPES THE FUTURE . . .

THE ACU-ARC RULER

The revolutionary new Acu-Arc ruler is designed to provide the draftsman with a straightforward and accurate method of drawing arcs of circles of any radius from 7" to 200" or more. No other single instrument is available to draw arcs of circles of such a large range of radii. Nor is there any other instrument available to draw arcs of large circles quickly, easily and accurately.

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#9603. The ultimate in precision lead holders. Perfectly balanced to eliminate drafting fatigue.

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CYLINDRICAL
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FOR
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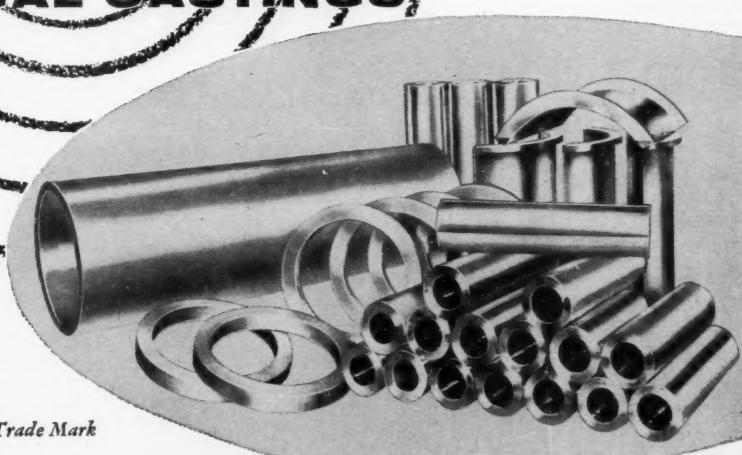
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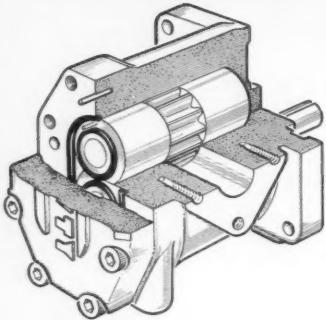
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Dowty hydraulic gear pumps are available in four basic sizes . . . 14 models . . . one suitable for practically every application! Deliveries from $\frac{1}{2}$ to 60 G.P.M. — pressures up to 2,500 psi. Top quality, competitively priced.

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Design Features

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For further information mark No. 124

People . . .

. . . and events

First detinning plant

Canada's first detinning plant is under construction on a 7½ acre site in Hamilton, Ont., at a cost of one million dollars. It will be operated by M&T Products of Canada Ltd., subsidiary of Metal & Thermit Corp., a major detinning company and manufacturer of tin chemicals, coatings, electroplating chemicals, minerals, welding equipment and electrodes.

The new Canadian plant will use the modern alkaline process to remove tin from high quality tin plate scrap produced in can-making operations. Tin chemicals obtained from the detinning operation will make M&T Products the first Canadian source of supply for sodium and potassium stannate, used for plating with tin and for immersion coating of aluminum pistons for internal combustion engines.

The plant will be completed before the end of the year.

In brief

Gurney Scale Co. Ltd., Burlington, Ont., has appointed Arcan Eastern Ltd., Hamilton, Ont., as its sole Canadian distributor.

Union Carbide Canada Ltd. has increased its 60 scholarships from \$2,000 to \$2,500 each and its four fellowships from \$1,500 to \$2,000. The scholarship program's eligibility requirements have also been broadened.

The Canadian division of Wheelabrator Corp. of Mishawaka, Ind., has been succeeded by a new firm, Wheelabrator Corp. of Canada Ltd., with a plant in Scarborough, Ont., and an office in Montreal. Harold M. Miller is president and Robert A. Campbell vice-president in charge of the Canadian operation.

Graver Water Conditioning Co., a division of Products Tank Line of Canada Ltd., has been awarded the contract to design and manufacture equipment to remove corrosive gases from boiler feedwater in Canada's first large nuclear powered electric generating station near Kincardine, Ont.

Wainbee Tools Ltd., Toronto, has been appointed exclusive Canadian distributors for the Clippard Instrument Laboratory Inc., Cincinnati, Ohio, manufacturer of miniature air valves, cylinders, valve solenoids, fittings and accessories.

A new company, I-T-E Circuit Breaker (Canada) Ltd., has incorporated BullDog Electric Products (Canada) Ltd. and Eastern Power Devices Ltd. The two latter companies will operate as divisions with their present management and staff.

Lockheed Aircraft Corp. has established a corporate regional office in Ottawa with Erik Nelson in charge.

The American Society of Tool and Manufacturing Engineers has affiliated with the American Association for the Advancement of Science. The affiliation emphasizes the growing link between pure science and the engineering sciences.



Fournier



Ross

Personalities

H. A. Mullins, P.Eng., a supervising engineer for Du Pont of Canada Ltd., has been elected chairman of the Montreal branch of the Engineering Institute of Canada.

John H. Ross, P.Eng., has been elected president of the Association of Consulting Engineers of Canada. He is president of John H. Ross & Associates Ltd., Toronto.

Appointments

R. N. Fournier has been appointed a vice-president of Canadian General Electric Company Limited. Mr. Fournier is a member of the Association of Professional Engineers of Ontario and the Engineering Institute of Canada.

John D. Campbell has been elected president of Canadian Westinghouse Co. Ltd., succeeding George L. Wilcox, who becomes vice-president of the U.S. parent.

L. Buell Manning has been appointed vice-president and general manager of A. C. Wickman Ltd.

L. E. Dolphin, P.Eng., has been appointed project engineer (access lines) for the CNR's Toronto terminal project.

Ernest H. Gilliatt, P.Eng., has been promoted to assistant general superintendent of transportation at Toronto for the CNR's Great Lakes region. He was formerly transportation engineer in Montreal.

M. C. Finley has been named vice-president, manufacturing at The Pedlar People Ltd., assuming the duties held by J. A. Murphy, who has retired after 42 years with the company.

Maurice F. Malone has been appointed to the new position of sales supervisor, industrial products, Canadian Resins Division of Shawinigan Chemicals Ltd. *

New products and materials

Small motor

A new type of permanent magnet motor may be used in place of conventional direct current motors in many applications. The basic design may also be used as a small generator for possible use with small gasoline engines for lawn mowers and outboards. The new motor has fewer electrical circuits and fewer field failures may therefore be expected. Redmond Co.

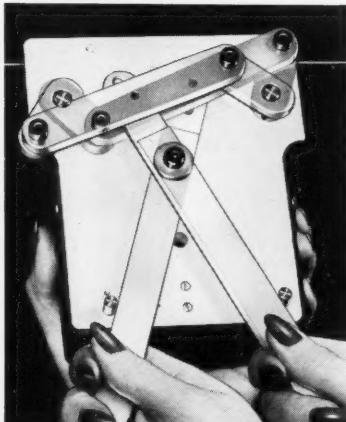
Circle 324 on Reader Service Card

Ice-proof lock

The severest icing conditions do not affect a new padlock suitable for substations and other locked outdoor enclosures. The flush fit lock cover is snugly held in position by a tough spring clip. The lock shaft is free-wheeling and cannot freeze. CLM Industries.

Circle 325 on Reader Service Card

Compound lever



An ingenious mechanism permits quick and automatic tension measurement of any filamentous material under critical conditions. The two-position view of the instrument (see cut) shows the two outer reference rollers as lifted by moving the long hand-lever to one side. This separates the rollers and the material to be tested is then placed in position. When the long lever is moved, the spring-restrained centre roller (not shown in this back view) is depressed by the wire in relation to the wire tension. Tensitron Inc.

Circle 326 on Reader Service Card

Vibrating conveyor

Gentle conveying action of friable materials without degradation of material is promised by a new line of mechanical vibrating conveyors. Conveying action can be adjusted to suit the material-handling characteristics of each material by an adjustment of the amplitude of

the drive stroke. The conveyor is offered in widths from 12 to 48 in. and in lengths to 30 ft., with capacities ranging to 200 tph. Jeffrey Manufacturing Co.

Circle 327 on Reader Service Card

Scale attachment

Accuracy within .0002 in. in positioning and relocating points on milling machines, lathes and similar equipment is provided by a scale attachment designed to hold to close tolerances by overcom-

ing errors due to backlash and worn lead screws. Measurement of hole centres and other time-consuming locating operations are eliminated and compensation is made for machine setting errors. Easily mounted on a wide range of machinery, the attachment is available for table lengths from one to 15 feet and is adaptable for one, two or three axle operations. Edgcomb Engineering & Engraving Co.

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SAVE "DOWN TIME" WITH

COOPER

split ROLLER BEARINGS

Cooper Split Roller Bearings have all the advantages of conventional roller bearings, PLUS being SPLIT—right down to the shaft! For mounting, Cooper bearings are assembled around the shaft—not pushed or pressed on the shaft. They may be mounted where it is impractical or impossible to mount conventional solid race bearings.

The unique SPLIT feature saves "down time", money, and space. With Cooper bearings you get all the advantages of regular roller bearings with a Big PLUS!

Superb construction, high load-carrying capacity, and long life make Cooper Split Roller Bearings the first choice with designers and maintenance engineers.

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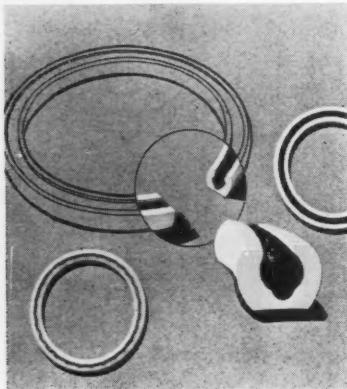
For further information mark No. 150 on Readers' Service Card

Midget air cylinder

A new midget air cylinder is designed to operate latches, trips, signals, etc., as well as to be used with jigs and fixtures, interlocks and ejectors. Of brass construction except for the steel piston rod, the cylinder is of $\frac{3}{4}$ in. bore and supplied with either clevis or neck mounting. Martonair (Canada) Ltd.

Circle 329 on Reader Service Card

Spring expander



Lack of resilience, which has been a prime disadvantage in the use of Teflon as a sealing material, has been overcome by the introduction of an internal

expander which maintains a continuous mechanical force against the sealing surface. The patented expander can be either stainless steel or synthetic rubber. The rings need no adjustment and range in size from $\frac{1}{8}$ in. to 15 in. ID. Tanner Engineering Co.

Circle 330 on Reader Service Card

Servo demonstrator

A servo demonstrator has been developed to provide an instrument to relate servo theory, design and application in a clear and understandable manner for instructional use. The instrument includes a high performance velocity and position feedback servo system mounted on a heavy duty 33x49 in. demonstration panel. The amplifier sub-system contains a single vacuum tube preamplifier stage and a pair of matched 20,000 current gain composite transistors as the push-pull drivers. Advanced Research Associates Inc.

Circle 331 on Reader Service Card

Circular slide rule

Since the accuracy of a slide rule is largely determined by its length, a pocket slide rule of circular design can easily match a 10 in. rule on this score. Three low priced types have recently been introduced, of which the largest carries on the front the K, A, D, C, CI, B and L

scales, and on the back the LL2, D, C, S, T1, T2 and ST scales. Carsen Instruments Ltd.

Circle 332 on Reader Service Card

Swivel lock



A new swivel lock developed for Albion casters can be securely positioned with very little effort and can even be locked or released by a touch of the foot. Any locking positions desired can be furnished by machined slots in the caster yoke base. In the locked position a steel pin is held securely in these slots by a heavy duty coil spring. Rugged strength has not been sacrificed to this easier control. United Steel Corp. Ltd.

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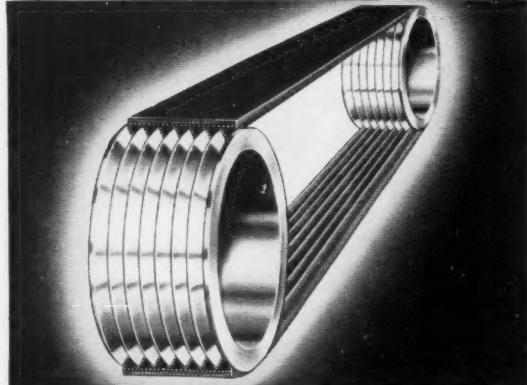
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backlash

J'accuse

For the second time in almost as many months, AMP Inc., Harrisburg, Penna., has won a lawsuit. It filed suit against another manufacturer of electronic components charging that one of that company's officers had improperly appropriated designs and other materials while he had been employed by AMP.

The U. S. district court in Brooklyn, N.Y., ordered the defendant to return all AMP drawings, prints, specifications, etc. misappropriated by ex-employees. The defendant was also perpetually enjoined from using any of the information contained in these drawings.

In the earlier suit AMP brought a charge of patent infringement against a competitor which had copied its bolt-cutting tool. A district court dismissed the charge, saying the invention was obvious, but the U. S. circuit court of appeals in Chicago reversed the earlier judgment, saying the AMP device "makes a significant contribution to the mechanical art . . ."

Wanted: top executives

There is apparently no longer a mass need for engineers — any sort of engineers. The need today is for engineering executives.

A survey of executive job opportunities in 133 large companies in 27 states and Canada shows engineering executives in fourth place on the "most wanted" list, after sales, manufacturing/production and management/administrative executives. Of the 292 well-paid jobs (\$10,000 to \$75,000) available or expected within six months, 14.7% were for top engineering management.

A similar survey made by the same organization (Executive Manpower Corp., New York) early in 1960 showed engineering executives in second position (22.5%). Sales executives were also in the lead in that survey.

The latest survey shows that executive jobs now pay more. A new high of 30.8% of all vacancies will pay \$20,000 a year or more, compared with only 15.5% in the earlier survey.

The companies expected that engineering executives would be hardest to find (31.5% of companies reporting), with sales executives second (29.8%).

Other interesting facts to emerge from the survey: The 133 companies averaged annual sales of \$113 million; salary and bonus is the favored compensation plan (72%); six out of ten reporting companies have management development programs, down slightly from 64.1%; fewer companies now find their executives within the organization than before (60.1% versus 64.1%).

It's a generic word

When a salesman tells you in an impressive manner that the object you are buying is plastic, he is telling you nothing at all. A furniture salesman wouldn't tell you that a table is made of wood, and let it go at that, nor a jeweller that a ring is made of metal.

The word plastic, like wood and metal, means a general category of similar materials, but each with its own characteristics and properties. Each one is different. It is the differences that make them so versatile.

Plastics are not substitutes; they are a class of materials that fit in between woods and metals, between ceramics and wood, between leather and rubber. They were developed and are used because they may be more colorful, more durable, less expensive, or lighter than other materials.

Engineering in the U. S.

Engineers' salary levels in the United States rose approximately 5% per year between 1958 and 1960, according to a survey conducted by the Engineers Joint Council. The over all median annual salary now stands at \$9,600. Of particular note is the 14.3% increase in the total professional income of engineering teachers in the same period.

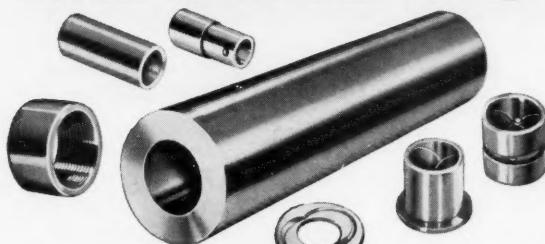
Engineers are a relatively young group in the U. S., with median age of 32, based on a graduation average of 22. What happens to the old engineers? Perhaps they just fade away.



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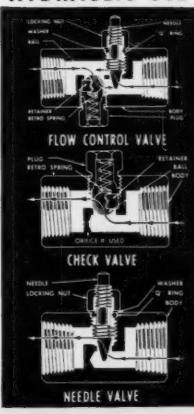
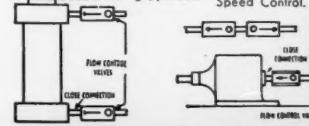
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Editorial

Could we really qualify as professionals? ...

... the test is a lot tougher than most of us realize

Let's face one inescapable fact right at the beginning of this discussion—the mere act of registering with one of the provincial associations does not make an engineer (whether graduate or otherwise) a "professional." It merely means that, being an engineer with certain minimum qualifications, he is now registered; he is, in fact, nothing more or less than a "registered engineer." He has a long way to go, if he ever reaches the state at all, to become a true professional.

At the recent annual meeting of the Association of Professional Engineers of Ontario much was said about the **professional** and the **professional attitude**. A panel of four speakers, for instance, approached the subject from their own varied backgrounds and training—they therefore gave four different and stimulating addresses. We trust everyone listening paid careful attention to their words. All four did mention one common matter of importance, when they said that a **true professional attitude was born and developed only through many years of engineering experience**.

How then, we ask, can anyone newly graduated from university and with the usual one or two years of practical experience (and that very often in anything **but** engineering) be regarded as a true professional?

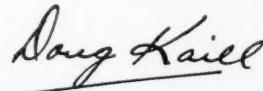
Two other developments during the afternoon session of the APEO cast some doubts in our mind as to the professional stature of some engineers. One engineer wasted 20 minutes of our time (and that of at least 500 others) during the open discussion period by merely reciting his own history as an engineer and how he came to join the association. We still don't know what his purpose was in speaking—he had no proposals to make for the betterment of engineers in general—no motions to place before the meeting. Would you say this was the action of a true professional?

A second engineer, after much noise and gesticulation, moved that "... the APEO Council be instructed to spend \$10,000 in 1961 in public relations work on behalf of the members, and that a good public relations firm be hired as consultants." The truth of the matter is that the APEO annually spends more than twice the amount proposed on just such a program, and for years has had as consultants one of the finest public relations firms in the business. Would not a true professional have been sure he had all the facts before he attempted to force action on such an important matter? And what of those who voted in favor of the motion?

A true professional cannot be legislated into existence. He cannot be registered into existence, either. **He only becomes a true professional when those associated with him recognize his professional qualities, as demonstrated in his attitude to his vocation, and acclaim him as a professional.**

Perhaps it is time the engineers of Canada stopped kidding themselves and set up a proper program to register engineers—on a nationwide basis—and then let the individual engineer earn his own recognition as a professional.

As one nonprofessional engineer said to us recently, "If you have to ask for recognition as a professional, you probably don't deserve it."



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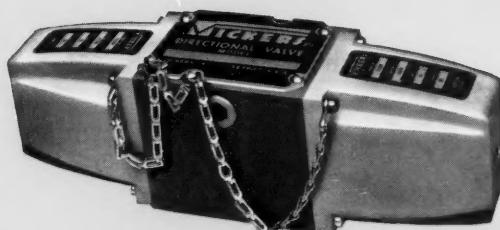
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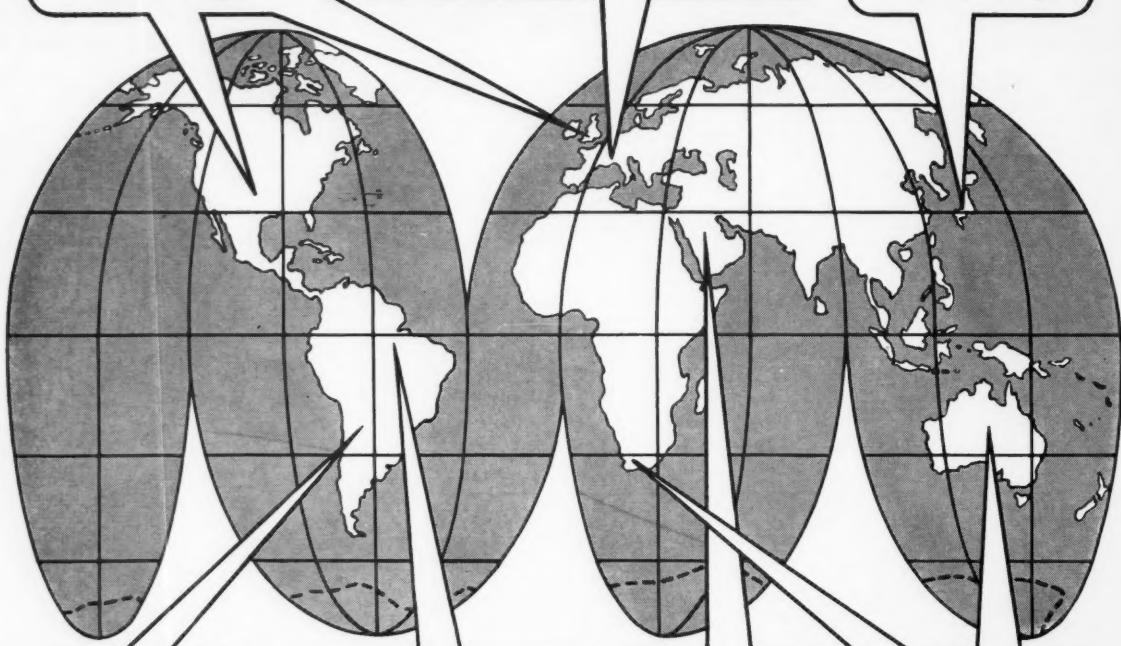
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